

## Development and Implementation of Renewable Energy Technologies in Sewage Treatment and Flood Prevention Facilities in Hong Kong

(by Drainage Services Department)

Being the third largest energy consumer amongst government departments in terms of electricity consumption (about 300 million kWh per year), the Drainage Services Department (DSD) has put in place various types of installations to harness renewable energy (RE), including biogas-fueled combined heat and power (CHP) generating systems and micro-turbine systems, photovoltaic systems as well as hydro-turbine systems in its sewage treatment works (STW) and pumping stations. In the past few years, the RE generated by DSD, which was more than 27 million kWh a year, was able to meet over 8% of its energy demand. Currently, the total installed generation capacity of the RE projects in DSD is around 7.3 MW.

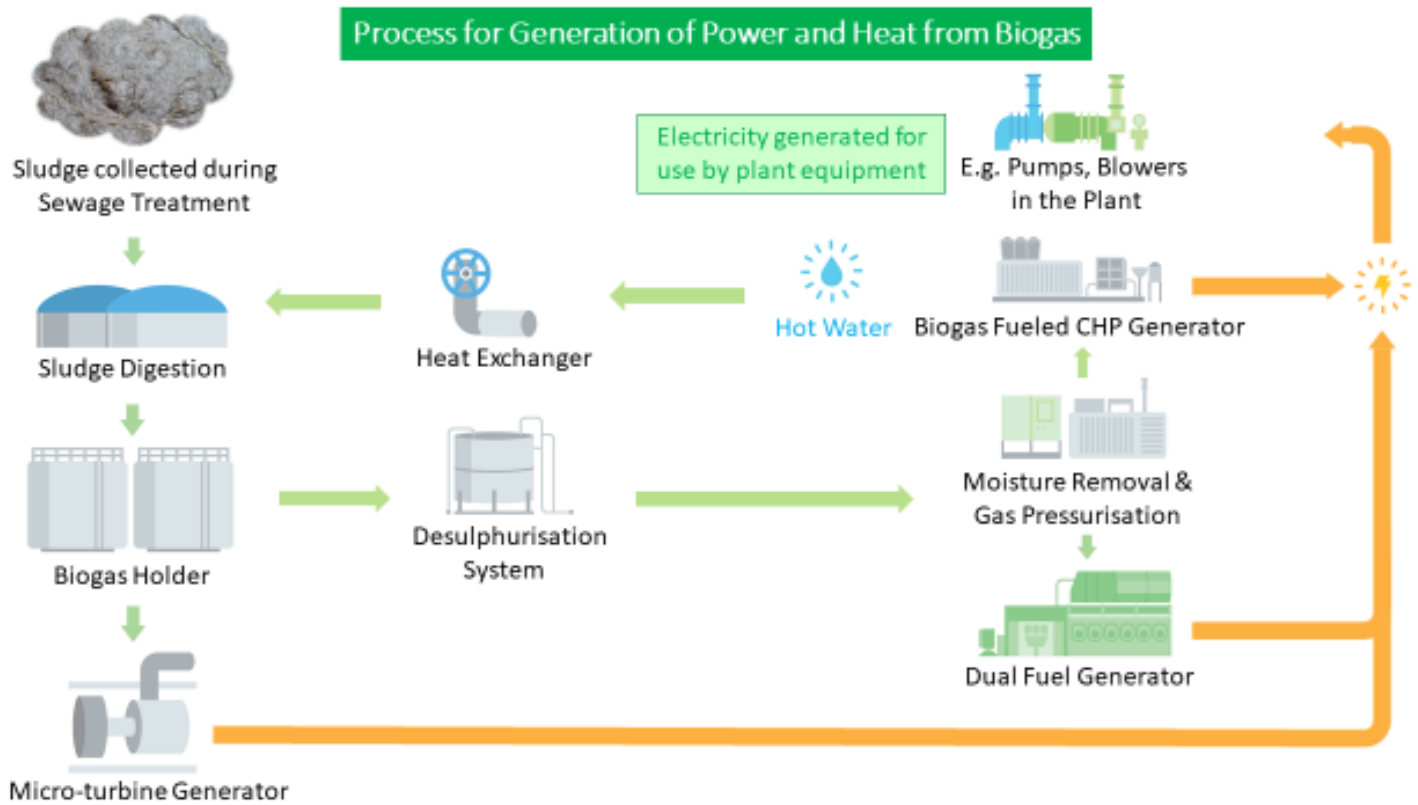


### CHP Generating Systems, Micro-turbines and Organic Rankine Cycle Generators for Utilisation of Biogas

Biogas, a RE source, is produced in the course of sludge treatment in secondary STWs.

To harness the biogas to generate electricity and heat, DSD has installed 7 CHP generators and 3 micro-turbines in DSD's major secondary STWs, including Sha Tin STW, Tai Po STW, Shek Wu Hui STW and Yuen Long STW. The total installed generation capacity is some 5.4 MW. The heat and electricity so generated are for maintaining operating temperature of sludge digesters to enhance anaerobic digestion of sludge and operation of in-house electrical equipment respectively. While an additional 1.4 MW CHP generator is being installed in Sha Tin STW,

one more CHP generator of around 600 kW will be installed in the STW in 2022/23 for enhancing utilisation of the biogas produced.



To further harness the waste heat from CHP generators, an Organic Rankine Cycle system with an installed generation capacity of 100 kW is being installed at Tai Po STW to convert the waste heat to electricity. More generators of such are planned to be installed in various STWs.

## Food Waste and Sewage Sludge Co-digestion for Production of more Biogas while Reducing Sludge/Waste Volume

Echoing the blue-print on waste management as highlighted in the Policy Address 2016, DSD and the Environmental Protection Department (EPD) are working together to conduct a pilot project on the co-digestion of 50 tonnes commercial & industrial food waste and the sewage sludge at Tai Po STW. Experiences in Europe, Korea and the US have demonstrated that the co-digestion process can help raise the food waste treatment capability, generate more biogas and produce less sludge, when compared to digesting food waste and sludge separately. For the Tai Po co-digestion pilot project, EPD had constructed a food waste pre-treatment plant in the Shuen Wan Leachate Pre-treatment Plant and DSD had carried out modification works for its sewage sludge digestion facility at Tai Po STW. The food waste and sewage sludge co-digestion pilot plant at Tai Po STW commenced food waste intake in mid of 2019. Under the pilot project, EPD is responsible for collecting, delivering and pre-treating food waste as well as pumping the pre-treated food waste to the designated digester

at Tai Po STW, while DSD is responsible for the operation of the digester and utilisation of biogas to generate heat and electricity for use within the plant.



In addition to the co-digestion pilot project in Tai Po STW, the second trial project of food waste (with sources from both the municipal and commercial & industrial sectors) and sewage sludge co-digestion in Sha Tin STW is currently in the construction stage. Food waste pre-treatment facility will be constructed by EPD inside Sha Tin STW while DSD is taking forward the modification of existing facilities for co-digestion of food waste and sewage sludge inside Sha Tin STW. The trial project is planned to have a treatment capacity of up to 50 tonnes per day of food waste. It is anticipated that the operation of the trial would commence by mid 2023.

To fully utilize the sludge digestion capacity and capitalize on the available sewage sludge for generation of RE, it is planned to divert chemically enhanced primary treatment (CEPT) sludge to the Sha Tin STW for anaerobic digestion and/or co-digestion with food waste to be provided by EPD. A project for constructing CEPT sludge reception and dilution facilities at Sha Tin STW to receive and dilute imported dewatered CEPT sludge before digestion is being implemented. The works commenced in October 2021 for commissioning by end 2022 and operation in January 2023. The designed capacity of the facilities is 100 tonnes per day and initially 80 tonnes of dewatered CEPT sludge per day will be diverted from San Wai STW to Sha Tin STW.

## Photovoltaic (PV) Systems for Harnessing Solar Energy

Over the years, PV systems of various scales and types have been installed at some 29 of DSD's STWs and



pumping stations, with a total installed generation capacity of around 1.8 MW. Notably, the solar farm in Siu Ho Wan STW, with an installed generation capacity of 1.1 MW, is the largest PV system amongst all government facilities in Hong Kong. DSD is exploring the provision of more PV systems at various sewage treatment and flood prevention facilities including thin film PV panels that can adapt to curved surfaces, steppable PV panels, bi-facial PV panels as well as floating PV systems. One of these projects is the installation of thin-film PV panels at Stonecutters Island STW, which fully utilises space such as sedimentation tank covers for solar power generation. Upon completion in 2014/15, this thin-film PV system will be the largest of its kind in Hong Kong, with a total installed generation capacity of over 1 MW.



Thin Film PV Panels on curved sedimentation tank covers at SCISTW



Steppable PV Panels at SHWSTW (Trial)

With more PV projects coming on stream in the coming years, the total installed generation capacity of the PV systems in DSD would reach 7.6 MW.

### Hydro-turbine Systems for Harnessing Sewage/Effluent Flow Energy

A 23-kW hydro-turbine system was installed at the drop shaft of two of the sedimentation tanks in Stonecutters Island STW in end 2018. While a second system is being commissioned, the third and fourth systems are planned to be installed in the STW.

### Looking Ahead

DSD will continue to strive identify further opportunities in terms of RE sources and technologies to harness even more RE. In addition to installing more PV systems and hydro-turbine generators, sewage sludge and food waste co-digestion facilities will be incorporated in the construction and/or major upgrading of the sewage treatment works at Shek Wu Hui, Yuen Long, Yuen Long South, Hung Shui Kiu and Tai Po.