Water Convention 2021 Key Takeaways

<table>
<tr><td colspan="2">THEME 1 – DELIVERING WATER FROM SOURCE TO TAP (NETWORK)</td></tr>
<tr><td>Session Title</td><td>Key takeaways</td></tr>
<tr><td>1.1 Network Planning for Resilience</td><td>1. Harnessing smart technologies and automation, embracing data analytics to better understand and optimize network performance.

2. Need to consider the various potential risks, and evaluate to determine the more viable option between engineering solutions and Response and Recovery.

3. Asset Management is more than just life cycle assessments, studies on the relevant soil/area, design and replacement planning also play an important part in managing assets.

4. Operational management focusses on optimization of dispatch and nodes. It also consists of pressure management, which is aided by technology, smart meters and data analytics.

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<tr><td>1.2 Optimising Network Operations</td><td>1. "Calm Network" approach requires (i) Intelligence acquisition to understand network behaviour; (ii) Reducing transient pressure with well-maintained valves; and (iii) online monitoring at critical points.

2. Pump optimization process can consist of prioritisation, pump establishment and pump monitoring.

3. Forecasting systems for pump optimisation predictive recommendations involves data driven and physics-based models.

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Water Convention 2021 Key Takeaways

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<tr><th colspan="2">THEME 1 – DELIVERING WATER FROM SOURCE TO TAP (NETWORK)</th></tr>
<tr><th>Session Title</th><th>Key takeaways</th></tr>
<tr><td>1.3 Water Conservation and Efficiency Measures</td><td>

1. The main drivers of change towards adopting more efficient water conservation methods include climate change, increasing water demand and technology.

2. Smart metering technology can solve both economic and behavioural issues in water conservation.

3. The size of meters matter in determining the accuracy of the meters.

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<tr><td>1.4 Non-revenue Water</td><td>

1. Multi-pronged approach (involving accurate metering, proactive leak detection, network management and legislation) is needed to manage and minimise non-revenue water (NRW)

2. Current technologies are based on acoustic methods and their main focus is on leak detection. There are still limitations due to signal attenuation and interferences from urban noises.

3. Sensor technologies, IoT, cloud computing and data analytics have become increasingly important in the management of NRW.

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Water Convention 2021 Key Takeaways

THEME 1 – DELIVERING WATER FROM SOURCE TO TAP (NETWORK)	
Session Title	**Key takeaways**
1.5 Smart Water Grid	1. Digital twin makes possible predictive rather than reactive maintenance. This ability to forecast the state of the system allows for system components to be maintained predictively. This is in contrast to conventional methods of reactive maintenance, or scheduled maintenance at fixed intervals. Predictive maintenance is advantageous over either of the conventional methods in that it keeps the network in a healthy state, yet provides cost savings as assets are repaired when necessary. 2. The importance of an integrated platform. Having data in the same place allows operators to use them in conjunction and as such obtain better insights. For example, by studying the intercorrelation of flow and acoustic data, operators can better identify abnormal events, e.g. more accurately identify a water hammer in a section of the pipeline using both flow and acoustic information. 3. Directed investment in digital transformation. By first identifying its priorities, the utility can direct its digital investments to what is most needed. It should first consider the problems that it wants to solve, then consider the suitable technology to solve these problems. This ensures that capital and operating expenditure is purposefully spent on the technologies which are most pertinent to organizational needs. 
1.6 Smart Metering	1. Smart meters offer huge opportunities to reduce NRV (non-revenue water): The aggregation and analysis of data uses District Metered Area (DMA) meters to compare and contrast the consumer behavioural patterns and water losses of each zone. This leads to greater efficiency and higher cost-savings as utilities can prioritize zones with the highest net losses. 2. Firms demonstrated the use of smart meter far beyond just for measurement of water consumption. The latest version of smart meter allows for monitoring and localization of leaks in both water supply network and residential units simultaneously. Integration of other sensors coupled with AI-based solutions give utilities smarter and cost-effective ways to manage large amount of assets. 3. It is important to note that a utility grade communications network and a good battery life is essential to unleash the full potential of any AMI-based solutions. Furthermore, any data collected from smart meters must be translated into actionable items to reduce NRV.

Water Convention 2021 Key Takeaways

THEME 1 – DELIVERING WATER FROM SOURCE TO TAP (NETWORK)	
Session Title	**Key takeaways**
	
1.7 Asset Management for the Distribution Networks	1. Conventional asset management focuses on reactive repairs, which often associates with inconvenience and high cost. The latest conditional assessment solutions demonstrated robust data collection, careful risk assessments and astute decision-making which helped utilities to save tremendous cost in asset renewal. 2. Integration of acoustic leak detection system enables identification of premature failures in the water network, such that the repair crew can schedule repair work in advance, minimising possible disruptions caused by supply outages. 3. Many countries have adopted asset management benchmarking program as the fundamental building blocks to design and develop asset management roadmap. It is also critical that the water industry continues shifting the focus from reactive to proactive paradigm, improves knowledge sharing and embraces transformation to ensure sustained business and customer satisfaction. 

Water Convention 2021 Key Takeaways

THEME 2 – DELIVERING WATER FROM SOURCE TO TAP (TREATMENT)	
Session Title	**Key takeaways**
2.1 Improving Water Treatment	1. Use of 3D CFD and compartmentalized modelling can provide and predict the water quality and performance of water treatment processes, for more practical and better decision on operational changes. 2. UV-LED & Chlorination in water treatment was observed to have no significant increase of THM and HAA formation at natural pH. However, HAA formation increased at acidic pH. 3. Using Ozone AOP treatment is a more cost-effective solution to solve algae bloom and odour issues in water treatment processes. It also reduces THM formation, significant reduced of laboratory sampling and cost savings on the treatment etc. 
2.2 Innovation in Desalination	1. Reverse cleaning (reversing flow from tail end to feed end of RO vessel) is efficient in removing biofouling. Cross piping is an easy retrofit to modify existing CIP reverse cleaning system. 2. CAF is efficient in removing bacteria count (suppress bioaccumulation on RO membranes), though removal rates of dissolved organic matters was found to be negligible. 3. Desalinating 1000m^3 per day consumes about 10,000 tonnes of oil per year. 

Water Convention 2021 Key Takeaways

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<tr><td>2.3 Membranes - Fast Forward</td><td>1. Other than fouling and energy consumption, future R&D on membranes should look into how to treat the concentrate and make good use of it.

2. To reclaim water from chemical related industries, ceramic membranes can be applied to push up the recovery.

3. To monitor the health of RO membranes, future fouling sensors should be able to carry out online monitoring within the membranes.


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<tr><td>2.4 Expanding Ceramic Membrane Applications</td><td>1. Pre-ozonation enables in-situ cleaning of PWNT's ceramic membranes, therefore CIP is not required.

2. Ceramic membrane used for wastewater application can reach sustainable flux of 245 LMH by applying an ozone dose of 7mg/l.

3. Surface modification using graphene oxide quantum dots (GOQDs) of ceramic membranes is an effective pathway to improve their fouling resistance.


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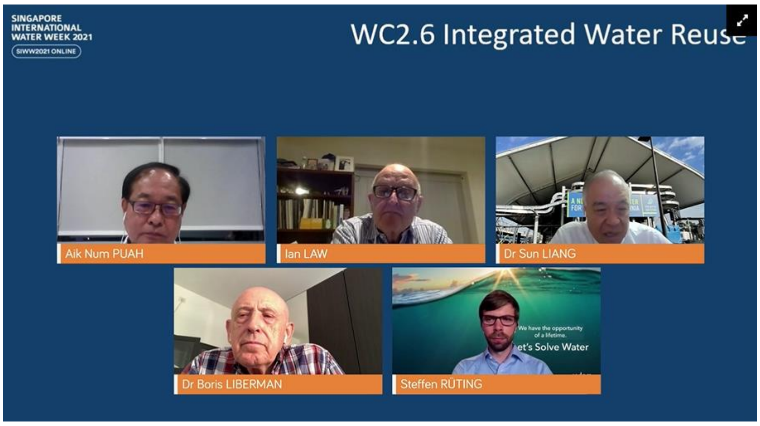
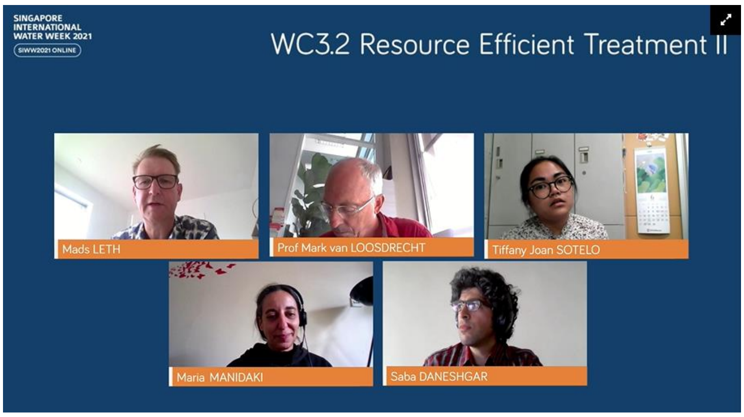
Water Convention 2021 Key Takeaways

THEME 2 – DELIVERING WATER FROM SOURCE TO TAP (TREATMENT)	
Session Title	**Key takeaways**
2.5 Emerging Contaminants - Practice and Science	1. PFAS is a problem that is accelerating worldwide and even now, the analytical capability lags far behind the industrial production of such compounds. 2. in-silico modelling of complex ozone disinfection kinetics is now a reality. It can be used for planning, design, operations and virtual piloting. 3. DOC is a growing area of challenge in many countries. Driven by impairment of water resources but also stricter specifications for product water quality, especially drinking water. 
2.6 Integrated Water Reuse	1. Pulse Flow RO is an innovation that could help to solve the several problems regarding fouling, scaling and bio-fouling of a conventional RO system. 2. UV/HOCl based AOP can be considered as a safe and valid approach to be integrated into existing treatment train for NEWater as it has shown to reduce NDMA and increase Total Residual Chlorine levels in the product water. In addition, it does not form disinfection by-products (e.g. HAAs, TTHM, TOX etc). 3. Some sources of potential future studies could include engaging in regulatory processes, conducting pilot and demonstration testing for advanced water technologies, and developing microbiological and chemical analytical methods. 

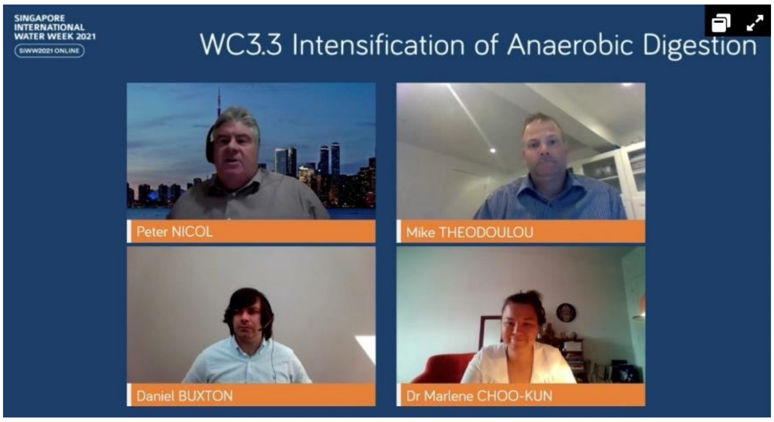
Water Convention 2021 Key Takeaways

THEME 2 – DELIVERING WATER FROM SOURCE TO TAP (TREATMENT)	
Session Title	**Key takeaways**
2.7 Intelligent Plant of the Future	1. There are many ways to optimize plants: technologies such as CFDs improve design of plants in the pilot stage, while machine learning algorithms optimize plants given its current constraints. 2. To implement new technologies (i.e. Machine Learning), bilateral communication between operators and contractors are critical to properly address problems. 3. Algorithms allow the testing of 'what-if' scenarios, which offer huge potential as they surpass physical difficulties in testing. 
2.8 Source Control in Advanced Reuse Applications	1. Source control is the first barrier and the wastewater treatment plant is the second barrier in any advance reuse application. 2. Singapore's trade effluent management framework consists of 1. Risk-based regulatory approach, 2. Sensors and Technology, 3. Stakeholder Engagement 3. Educating and engaging the public is an important step to source control. 

Water Convention 2021 Key Takeaways

THEME 3 – EFFECTIVE AND EFFICIENT WASTEWATER MANAGEMENT	
Session Title	**Key takeaways**
3.1 Resource Efficient Treatment I	1. Side-stream deammonification can (i) reduce nitrogen loading rate to mainstream; (ii) allow for reduction in aeration energy; (iii) produce energy from organic matter. Seeding can be a viable option to introduce a new treatment process provided that the growth conditions of a particular bacteria can be met. 2. Integrating AnMBRs with nitration-Anammox achieved simultaneous anaerobic digestion and low-carbon denitrogenation in mainstream sewage treatment. It also allows for energy recovery and reduced energy demand. 3. ZeeNAMMOX can enable a resilient and energy efficient deammonification process and is robust in recovering from shock or shutdown events. It allows for more efficient oxygen transfer, energy efficient partial nitritation (64% reduction in energy). Oxygen control is key to optimising growth of AOB. 4. The Standard Aeration Efficiency (SAE) Calculator and the Clarifier Efficiency tool can provide dynamic diagnostics targeting typical WWTP pain-points and allow for significant (20-30%) OPEX savings. Key issues include (i) data security and (ii) accuracy of sensor data. 
3.2 Resource Efficient Treatment II	1. Resource efficiency can involve energy and cost savings as well as recycling resources. The type of resource to be recycled (such as water, chemical, etc) would depend on the local network configuration and needs. 2. There are numerous novel technologies and pilot studies focusing on efficient wastewater treatment, including In-sewer Purification Pipe Technology and Model-Based Protocol for Mitigation of N_2O Emissions. The applicability of such technologies to a utility would require further study and careful consideration of the appropriate communities. 3. Alignment of the objectives along the entire supply and distribution chain is important for resource efficiency and decarbonisation in wastewater treatment. Leadership at all levels is also crucial and often overlooked; it ensures that the suitable policy for improving efficiency is actually implemented in the local network. 

Water Convention 2021 Key Takeaways

THEME 3 – EFFECTIVE AND EFFICIENT WASTEWATER MANAGEMENT	
Session Title	**Key takeaways**
3.3 Intensification of Anaerobic Digestion	1. SUEZ biological hydrolysis (BH) pre-treatment provides enhancement on volatile solid reduction, biogas generation and Class A biosolids generation on anaerobic digestion. BH through the "6-pack" method maximizes the utilization of existing digester assets, increasing effective capacity by 3 times without downtime. 2. Centralisation of sludge treatment in North Wales resulted in significant CAPEX, OPEX and WLC (whole life costs) savings. 3. Ultra-dewatering is economically attractive as it reduces sludge production by up to 75% compared to conventional dewatering. It also requires 3-4 less energy than a thermal dryer. If coupled to anaerobic digestion, overall biogas production is increased by 30-40% depending on sludge quality. 
3.4 Advancement in Solids Treatment	1. There is no such thing as waste, only wasted resources. It is critical that cities make use of valuable assets to maximise resource utilization and minimise waste generation. 2. Co-digestion of thickened surplus activated sludge (TSAS) with food waste produces higher specific biogas yield because (i) bacterial community can proliferate significantly; (ii) more balance carbon to nitrogen ratio as more carbon is contributed by the food waste. With co-digestion of food waste and sewage sludge, the sewage sludge gets more digestible. Food waste needs to be “properly polished”, i.e. packaging like plastics, contaminants and grit must be removed before buffering storage and digestion. 3. It is more cost-effective to build Thermal Hydrolysis Process facilities in existing wastewater treatment plants than to construct new treatment plants. 

Water Convention 2021 Key Takeaways

THEME 3 – EFFECTIVE AND EFFICIENT WASTEWATER MANAGEMENT	
Session Title	**Key takeaways**
3.5 Membrane Bioreactor Processes	1. Membrane Fouling has little impact on overall costs and provides insignificant challenge to membrane operation. Actual practitioner topics include: (i) Cost Benefit, (ii) Clogging, and (iii) Integrity & Disinfection. 2. Integrated Validation Plant (IVP), with an enhanced primary treatment with biosorption (A-stage) and a 5-pass step-feed low energy membrane bioreactor (MBR) (B-stage) allows for enhanced biological N and P removal without external carbon addition/pH adjustment (A-stage can capture 70% carbon); and Energy and resource efficient (with net process energy consumption of < 0.05 kWh/m3) 3. MBR and UV technologies in animal wastewater treatment plants (DAWTPs)are capable of achieving the treated effluent quality required for reuse with non-direct human contact. 4. Intermittent aerator for flat-sheet ceramic membrane systems shows the durability of ceramic membrane; stable operation was achieved; and 43% reduction of OPEX. 
3.6 Nutrient Removal	1. A systematic selection process based on site-specific constraints (e.g. footprint), process reliability, CAPEX, is important for the efficient design of STPs that meet project requirements. 2. The Partial-Denitrification/ Anammox (PD/A) process holds great potential towards mainstream nitrogen removal with lower N2O production and energy consumption than the conventional treatment process. 3. To maximise efficient nitrogen removal, carbon should be removed before the nitrogen removal process to prevent oxidation. 

Water Convention 2021 Key Takeaways

THEME 3 – EFFECTIVE AND EFFICIENT WASTEWATER MANAGEMENT	
Session Title	**Key takeaways**
3.7 Process Intensification: Integrated Approaches	1. There are many advantages associated with implementing process intensification technologies (e.g. IFAS, MBR, AGS), including improving treatment capacity, effluent quality, footprint optimisation, etc. 2. The integration of CFD with biokinetics modelling can effectively simulate the concentrations profile of different chemicals within a reactor, thereby reducing the need to build an actual pilot for evaluating alternative reactor design options. 3. Key considerations for choosing between different process intensification technologies include carbon, company consideration, unit costs, etc, but Singapore's land scarcity provide unique opportunities for MABR. 
3.8 Biofilm Processes	1. MABR is diffusion-based process; it is a biomass carrier that supports the growth of biofilm. The carrier material "breathes" and transfers oxygen to the biofilm at very high efficiency. MABR is a resilient biofilm low energy process because it is autonomous, seek dormancy capabilities, robust & rugged. 2. Downflow Hanging Sponge (DHS) reactor is an economical and an ecological wastewater treatment technology originated in Japan. The research demonstrated quick installation, easy maintenance, low power consumption and stable odourless operation of the plant in Khon Kaen City, Thailand - a growing urban city. 3. Membrane aerated biofilm reactor (MABR) technology can be the key to energy efficiency and process intensification of Wastewater Treatment Facilities. It is a state of art, innovative technology with huge potential when retrofitted into existing process volume to improvise treatment capability and reduce process aeration demand and greenhouse gas emissions. 

Water Convention 2021 Key Takeaways

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<tr><td>3.9 Advanced Modelling, Sensing & Control I - Outside the Fence</td><td>1. Advanced modelling sensing and controls had recent case studies to mitigate sewerage overflows caused by unexpected heavy rainfall and optimise sewerage and wastewater plant operations holistically.

2. Advancement in technologies needs to be coupled with change management in ensuring that operators are familiar and confident of operating the new system.

3. Accurate modelling, robust sensor networks and AI could be used to validate the data collected from the sensors. This certainty can be achieved by understanding anomalies in the data.


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<tr><td>3.10 Advanced Modelling, Sensing & Control II - Inside the Fence</td><td>1. A digital twin is a model with autonomous data exchange with the physical system.

2. An AI model can be used to develop a ‘soft’ sensor that estimates what a sensor might have read, without needing a physical sensor. This offers the potential to reduce capital and maintenance costs from using the physical sensors. It can also be used to check if a physical sensor is malfunctioning.

3. Laboratory results can be combined with predicted ammonia concentrations from the AI model to provide a dynamic forecast of future COD concentrations.


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<tr><td>3.11 Used Water Asset Management</td><td>1. Robotic platforms coupled with image/video analytics can be used to monitor hard-to-reach or hazardous interior spaces (e.g., DTSS).

2. Digitalization of previously analog equipment can help create energy-saving solutions even if energy-reduction was not the primary aim of the initiative.

3. Monitoring of BEP of specific pumps can yield more accurate indications for maintenance requirements than vibration-based methods.


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<tr><td>3.12 Microbial Ecology</td><td>1. Mechanistic modelling provides useful operation guidance for highly loaded anaerobic sludge bioprocesses. A model that accounts for shifts in methanogenic ecologies having distinct kinetic performance better predicts digester performance.

2. SND5 is preferable in wastewater treatment and can purify wastewater in a greener way. SND5 can be stored in dry powdered form and still be able to harness its power. SND5 plays a role in enhanced nitrogen removal.

3. Recurring pulse SRT disturbances increases the resilience of the AD (anerobic digestion) microbial community, functional flexibility in AD microbiome ensured continuous digester operation with minimal effect on digestate quality.


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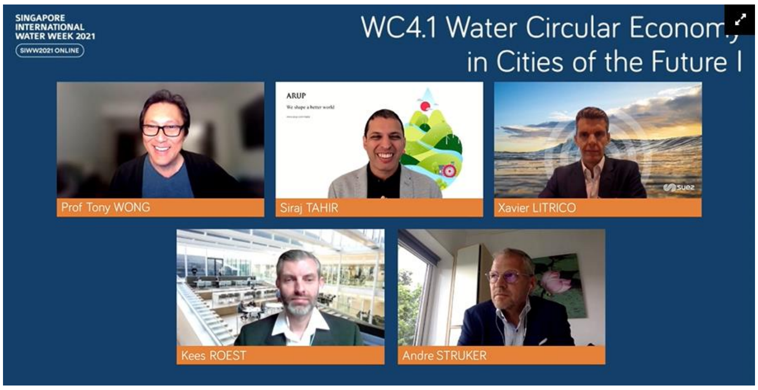
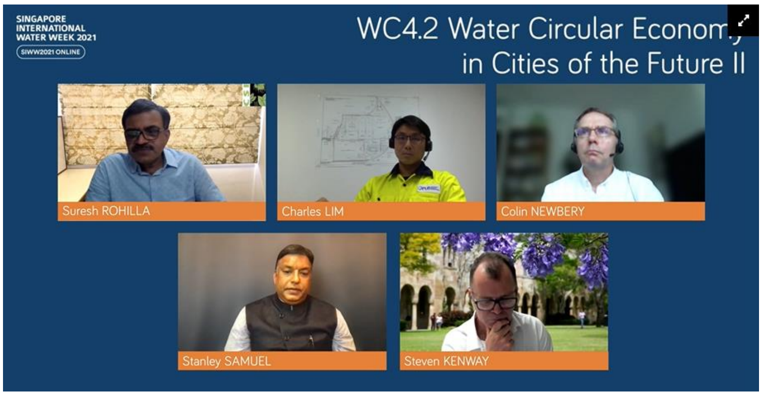
Water Convention 2021 Key Takeaways

THEME 3 – EFFECTIVE AND EFFICIENT WASTEWATER MANAGEMENT	
Session Title	**Key takeaways**
3.13 Industrial Wastewater Treatment and Reuse	1. Extensive wastewater characterisation at different generation points are essential to develop a good understanding of overall variability and to design an effective treatment system. 2. m-Fenton is a novel process that combines conventional fenton and MBR for synergistic benefits; sludge generated in the Fenton process can be removed/processed by MBR, or the major contaminants can first be removed upstream by the MBR, and the iron catalyst can be retained effectively within the system. 3. Although higher in CAPEX, advantages of SIAM technology are lower OPEX, lower sludge production, and production of biogas. 
3.14 Wastewater Treatment for Developing Countries	1. Technology/Technical solutions/Innovation is not the key problem/issue in the getting reliable drinking water in resource constrained communities. Some issues faced are (a) Trust between the communities and the government, (b) insufficient local capabilities to maintain and operate suggested engineering solutions, (c) solutions need to be tailored to the region and (d) best solutions to solve water problems is to involve locals and make them be part of it, rather than solely depending on others. 2. Co-treatment of Faecal Sludge and Septage (FSS) with Wastewater (WW) at an existing Sewage Treatment Plant (STP) that has adequate spare capacity was implemented and studied in the Bijnor Area, India, with low land and manpower requirements, and capital and operational expenditures. 3. Innovation is key in improving decentralised wastewater treatment for developing countries. Challenges faced by developing countries include rapid urbanisation, climate change, costs of services and energy constraints. Partnerships are key across the TRL value chain. 

Water Convention 2021 Key Takeaways

THEME 4 – CITIES OF THE FUTURE	
Session Title	**Key takeaways**
4.1 Water Circular Economy in Cities of the Future I	1. The Dutch has mapped its water chain which include the incoming/outgoing material flows in the Dutch water chain, which is crucial in progressing towards circular economy. 2. Concept of “biofactory”: nutrient mining from wastewater plant e.g. produce biofuel from microbial lipids accumulation, bioplastics from microbial PHA accumulation, bio-oil, biochar, acetic acid from pyrolyzed cellulose. 3. Fit-for-purpose water is key to circular economy. 
4.2 Water Circular Economy in Cities of the Future II	1. Digital Twin is useful in all 3 phases of a water facility: design, construction, and operation. It is a visualization tool for design, tendering and construction; provided an 'immersive' experience in design phase; and ensures the safe operation of a plant. 2. Water circularity can also be viewed from bottom-up, i.e. water cycle can also be applied on the household, building, and campus level. The concept of ‘fit-for-purpose’ water can also be implemented with more granularity on a decentralized level. 3. The involvement of the community is crucial in a circular water economy - the community should have an active role, as opposed to just being subscribers. 

Water Convention 2021 Key Takeaways

THEME 4 – CITIES OF THE FUTURE	
Session Title	**Key takeaways**
4.3 Hybrid Blue/Green/Grey Infrastructure	1. Hybrid (Blue/Green/Grey) Infrastructure brings about multiple benefits in the social, environmental and economic aspects. 2. Digitisation plays a key role to ensure a successful integration of hybrid (Blue/Green/Grey) systems. 3. Feasible and sustainable implementation of hybrid infrastructure requires its costs and benefits to be assessed in a holistic manner (economical, environmental, social etc.) 
4.4 Water for Liveability	1. Community participation is extremely important, and the community needs to be involved at each milestone of the project. The community can be mobilized to get necessary cooperation and support for project work. Outreach can also be increased by seeking inputs from community. Campaigns led by community can also develop a positive interaction around water conservation. 2. Utilize different valuable data streams such as flow gauges, water temperature and rain gauges to provide up to billions of data points which can then be analysed every single day. This will allow the prediction of water quality at different locations more accurate. When we see the unseen, we are able to act with conviction and this will impact progress. By using big data sources such as Internet of Things, big data and web, smart infrastructure can allow us to focus on outputs and outcomes. 3. Despite climate change and rising sea levels, most cities still need to be built. By creating new space on water, building floating structures on water is possible to gain space for food production and urbanization without competing for scarce land. 

Water Convention 2021 Key Takeaways

THEME 4 – CITIES OF THE FUTURE	
Session Title	**Key takeaways**
4.5 Basin Connected Cities	1. As cities increase in complexity due to climate change, urbanisation and growing demand of resources, it is important to take a coordinated/systems approach to the use and management of water resources 2. Given the complexity of climate change and its associated risks, a sectoral approach to risk management is no longer adequate — there is a critical need for integration 3. Digitalisation allowed cities to maximise their assets to deal with the complex risks and uncertainties that come with climate change and the management of water resources 
4.6 Social resilience of communities to climate extremes	1. The importance of working with local community in developing country to look for water source. 2. The importance of balancing social resilience and infrastructure resilience to solve water-related issues. 3. In developing country contexts with weak enforcement frameworks for pollution prevention and management, tradeable mechanisms offer a useful market-based instrument. 

Water Convention 2021 Key Takeaways

THEME 5 – WATER QUALITY & HEALTH	
Session Title	**Key takeaways**
5.1 Systems Approaches and Enabling Environment	1. Access to safe water and sanitation is a fundamental human right that is not accessible by many in communities hindered by poverty. Although stop-gap measures such as WASH systems are effective in the short term in alleviating diseases such as cholera, long term ground-up change requires a systems approach (rather than an issue-specific approach) targeting the fundamentals of economic improvement, mobilising political leadership, and investments in education and skills. Working with local political leadership mitigates the limitations of foreign aid (short duration of time working on the ground in less developed countries). Service delivery resilience can also be improved by moving away from charity run utilities to more professionalised services. 2. A holistic approach to water and sanitation safety in control of acute watery diarrhoea and cholera should be taken to stop cholera outbreaks. Countries need to shift focus from emergency response to investing more into development. When a country becomes more developed, hygiene and sanitation would improve and thereby end cholera. 3. Technology selection requires a whole-of-business approach as it is not just about the water utility. Involving as many stakeholders (e.g. customers, regulatory agencies, the environment) is key. Furthermore, we should avoid using generic ready-made solutions to solve problems. Innovation is about understanding the problem and finding as many new possible solutions. 4. Multi-sectoral interventions are needed to end cholera in as many as 20 countries, and key to this is establishing water, sanitation and hygiene (WASH) systems in affected communities. Red Cross' successful efforts in Somaliland, Yemen etc. provide practical case studies on how this can be achieved in a systematic way, targeting improvements in access to water sources, improvements to water quality, and establishing hygiene practices, among others. 

Water Convention 2021 Key Takeaways

<table>
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<tr><th>Session Title</th><th>Key takeaways</th></tr>
<tr><td>5.2 Source Tracking</td><td>1. Microbial Source Tracking (MST) are useful in many applications such as supporting wastewater-based epidemiology (e.g. normalization), environmental quality monitoring (e.g. NO-3 pollution origin) and lastly to be use in modelling & AI. Although, MST application still needs expert knowledge as it has no general standardised procedures yet.
2. Locally, Singapore reservoirs show rare faecal contamination, while water catchment canals close to human activities, industrial aquaculture, and agriculture show a higher risk to be exposed to faecal contamination.
3. Quantitative Microbial Risk Approach (QMRA) can be one of the ways to assess risk factor contaminants in water, with the following 4 approaches: (i) Hazard identification; (ii) Dose response models; (iii) Exposure assessment; and (iv) Risk characterisation.

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<tr><td>5.3 Wastewater Monitoring and Management</td><td>1. To use wastewater as information source in the current COVID-19 pandemic, firstly it requires collaboration between wastewater utilities and health monitoring parties. Sewage surveillance can serve as early warning of COVID-19 waves, and it is fast and efficient.

2. Effective wastewater surveillance programme relies on multiple critical steps which includes; planning, sampling, transport, storage, testing methods, data reporting and analytics and interpretation and use of data. Standardization is also key in achieving comparable results and an enduring capability for novel targets.

3. The continuous monitoring method of the COVID-19 virus in a regional sewer system and WWTPs might be effective in identifying potential hot-spot zones and the sources of variants. In addition, determination of wastewater characteristics and bacterial community displayed the potential to predict the outbreak of COVID-19. Even after COVID-19 outbreak, COVID-19 viral DNA was detected in sludge samples, indicating the presence of possible asymptomatic patients.

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Water Convention 2021 Key Takeaways

THEME 5 – WATER QUALITY & HEALTH	
Session Title	**Key takeaways**
5.4 Water Resources in Catchments/Reservoirs	1. Managing water security integrates basins, water quality and health directly; so that water can be managed as a system to bridge the challenges of sustainable development. 2. The impact of reduced light due to floating solar panels on surface water reservoirs had no significant worry regarding water quality and phytoplankton growth. 3. Traditional risk-based management framework can find it hard to parameterize microbial fate and transport processes as they are complex due to sensitiveness with hydrological and climate conditions. However, a 'risk index' modelling approaches avoids this unnecessary model complexity by considering key processes of microbial generation and transport, rather than explicit represent of microbial processes. 
5.5 Water Quality in Distribution Systems and Buildings	1. There is an increasing need for research and focus to be set on biofilm associated diseases as it causes severe health impacts such as death and high direct healthcare cost. 2. Online flow cytometry allows detection of drastic operational events in a fast and sensitive way, while online microbial fingerprinting (unique for each sample) is a tool for detecting water quality changes – differences in fingerprints are analysed by comparing baseline state (good quality water) and future state. 3. Microbiological and chemical contamination could be due to poor flushing practices, low pressure distribution systems and lead contamination from service lines. 

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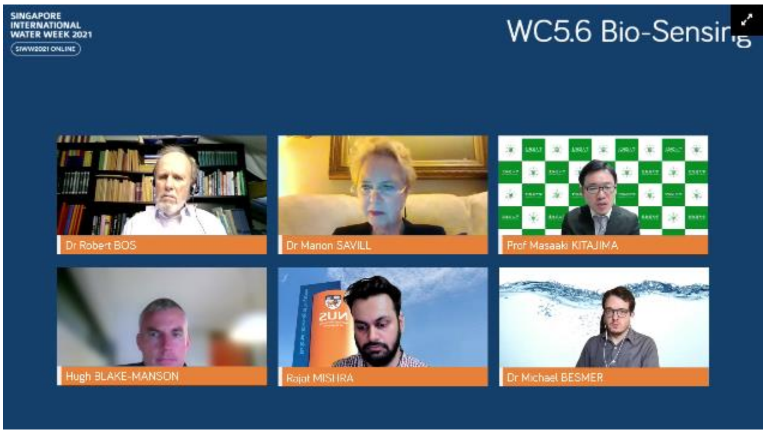
<tr><td>5.6 Bio-sensing</td><td>1. Major challenges in integrating biosensors to existing infrastructure since some of them are in harsh conditions and are hardly accessible.

2. Real time detection of intact cell concentration is a useful way of monitoring microbiological water quality. There is an obvious inverse correlation between total residual chlorine (TRC) and intact cell concentration. This is something important to bear in mind for operations.

3. Heat and all chemical treatments (chlorination and ozonation) will affect the membrane integrity, reducing the intact cell concentration.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Water Convention 2021 Key Takeaways

<table>
<tr><th colspan="2">TECHNICAL WEBINARS (HOT ISSUES WORKSHOPS)</th></tr>
<tr><th>Session Title</th><th>Key takeaways</th></tr>
<tr><td>TW.1 Water Resilient Cities, Lessons Learnt from Recent Extreme Events</td><td>

1. There is a need to increase institution capacity. Implementation of solutions are taking too long and different shareholders have to step up to facilitate and quicken the pace to be prepared for future challenges. Countries needs to take best practices from different success stories, adapt, scale and implement into their country in order to build resilient in their country.

2. Resilience does not come solely from improving on grey infrastructures or tackling hydrological issues. It involves taking a holistic approach where every shareholder is involved and integrated into the decision-making process as well as the solution.

3. Valuation of water has to be more accurate if the world wants to solve the water crisis. We must look at the value of water more holistically and capture all values of water in different sectors such as healthcare, food and manufacturing. The adoption of new and innovative digital solutions hopefully is able to draw more funding towards the industry and provide each and every one in the world clean water 24/7.

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<tr><td>TW.12 Climate Change, Water Quality and Health</td><td>

1. The exact progression of climate change and its effects on water quality and health may be uncertain to predict, yet the threat is absolutely certain.

2. There is still a great disparity in information and resources available between the urbanised/rural and higher/lower income across the world to be tackled.

3. There is a need to further strengthen inter-disciplinary and multi-sector collaboration and synergy amongst all the different stakeholders to proactively tackle the issue of climate change.

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Water Convention 2021 Key Takeaways

TECHNICAL WEBINARS (HOT ISSUES WORKSHOPS)	
Session Title	**Key takeaways**
TW.11 Resource Recovery – From Policy to Practice (Session 1)	1.Carbon recovery is not limited to methane. For instance, volatile fatty acids (VFA) can be captured instead to produce a wide variety of chemicals (i.e. Lipids), plastics or industrial products. VFA can also be recycled back into the plant for enhanced denitrification. Methane recovered can also be converted to methanol, fixing carbon in the process. Methanol can be reused in wastewater treatment for denitrification. 2. Hamburg, Germany, has adopted a self-sustaining, effluent-free house, which includes solar, greywater and sewage treatment to produce clean water and biogas respectively. 3. In developing countries, basic sanitation systems are a first step for resource recovery. There are opportunities for developing countries to adopt resource recovery as they have less established infrastructure and therefore more flexibility in changing their treatment processes. These countries should consider the highest value product that they wish to recover from waste streams and design the processes for that according to what they can afford. 
TW.13 Resource Recovery – From Policy to Practice (Session 2)	1. Downscaling desalination plants could reduce the overall cost through reduced conveyance cost. The NAWI research consortium is focusing on technologies to lower the treatment cost for modular plants which could reduce the net overall treatment cost for desalination. 2. With regards to mineral recovery from brine, there is a process that uses a membrane brine concentrator and crystallizer to produce pure NaCl salt. The waste product generated through this process is concentrated in Br. As there is a huge global market for NaCl and growing demand for Br, desalination costs could be recovered through their sale. 3. The Hazer process from Australia uses renewable methane to generate H_2 and graphite at a low cost and carbon footprint. The graphite produced from the hazer process has iron embedded in it and has magnetic properties and is therefore claimed to be a better purification medium as compared to conventional activated carbon, that can remove PFAS effectively. 4. Traditional treatment methods converts organics into CH_4 or CO_2 and N into N_2. However, there is a method that converts organics, N, P into microbial biomass instead. This can be used as food, fertilizer and biopolymers. The process may also be cost neutral.

Water Convention 2021 Key Takeaways

TECHNICAL WEBINARS (HOT ISSUES WORKSHOPS)	
Session Title	**Key takeaways**
	
TW.16 Reinventing Membranes – Present to Future	1. Ceramic membranes are typically more expensive than polymeric membranes in terms of upfront capital expenditure but can potentially have similar or lower life-cycle cost (20+ years) due to their durability and lower maintenance requirements. Their durability is both physical and chemical: they have good mechanical strength and resistance to aggressive chemicals, which simplifies cleaning and maintenance. The outlook on this technology is positive and R&D interests on ceramic membranes has been growing strongly in recent years. 2. Reinventing membranes must consider four levels of innovation, membrane, module, process and system. In terms of the membrane fabrication, R&D has been proposed to embed sensors into the membrane modules to detect fouling and other performance indicators. 3. The salt rejection of AQP-based ultra-permeable membranes is significantly affected by the interaction between different materials such as the protein, liposome, and polymers. AQP-based membrane shows its benefits in enhancing water permeation flux, but there is still a huge room to improve the performance of AQP-based membrane. 

Water Convention 2021 Key Takeaways

TECHNICAL WEBINARS (HOT ISSUES WORKSHOPS)	
Session Title	**Key takeaways**
TW.15 Water Industry Transformation to Achieve SDG2030 – Overcoming Bottlenecks	**[Implementing Policy and Technology]** 1. SDGs should be integrated into the core of each utility company and be the basis when formulating a company's vision and strategy 2. Policy and technology go hand in hand and are equally important to achieve SDGs 3. Traditional cost benefit analysis should be reconsidered given the magnitude of both initial costs and intangible benefits when businesses take up new technologies and initiatives **[Technologies to Ensure Access to Water and Sanitation for All]** 1. One of the biggest issues in inception of new technologies in a country is the justification of the business case (incentivising stakeholders to adopt it). What we can do is to utilise the SDG6 goals as a guideline to capture the intangible benefits in the BCA (benefit-cost analysis), thus allowing for a more holistic BCA versus a purely financial one. 2. A prudent method in implementing new technologies is to start small but have a roadmap of where things could go from there. Developing countries have high potential to assemble systems and technologies properly and allow other countries to reap the benefits from each other as well. 3. Creating and enabling the environment by ensuring that engineers and technicians are well-trained and funding is supporting a wide range of developing issues is important for successful implementation of technologies and policies in a country. **[Policy Approaches]** 1. Developing world may naturally want to focus on SDGs 6.1 and 6.2, but they should think of how they can leapfrog the developed countries to develop actions that can concurrently achieve 6.3 to 6.6. Achieving SDGs 6.1 to 6.6 is not a linear process. To craft a series of call to action that would resonate in the developed world. 2. An area of concern – how do regulators in developing countries have the capacity to champion this cause of leapfrogging? It is important to note that big city solutions are not necessarily solutions for small cities. If the SDGs fail at the institutional level, then the workforce cannot be expected to deliver clean water and sanitation. 3. To allow the acceleration towards fulfilling the sustainable development goals, a business impetus is necessary – one that considers the economic costs, not merely a financial one. If we are just focusing on reporting how much money was spent and not focused on achieving the outcomes, then we are not on the right path of achieving the SDGs.

Water Convention 2021 Key Takeaways

TECHNICAL WEBINARS (HOT ISSUES WORKSHOPS)	
Session Title	**Key takeaways**
TW.6 Utilities of the Future – Is Smarter Water Better Water? (Session 1)	1. Innovation is critical for the water sector. It is important to select purposeful technologies that are able create values for utilities through a structured evaluation framework, given the abundance of digital solutions in the market right now. 2. It is important for the whole organisation to be involved in driving innovation together. It should not be top-down driven for it to be sustainable. 3. In the long-term, it is beneficial for organisation to work towards operationalizing less-proprietary, flexible to prevent vendor lock-in and encourage innovation within the water sector. 
TW.8 Utilities of the Future – Is Smarter Water Better Water? (Session 2	1. Cybersecurity must be prioritized among the water sector. Although SMART water initiatives could make a utility more vulnerable to cyber threats, we should not curb the use of these technologies but adopt/ exchange best practices to implement the technology while staying secure. 2. On Interoperability and integration, it is critical that the initiatives is able to convince the staffs that it is useful, helps individuals and the organization to be more efficient, and improve service and response during incidents. 3. People and change management starts with leadership that creates a culture that embraces change while not forcing change through (i) Clarity: to be clear to the people on the purpose of the change; (ii) Communication: Listen to the people to understand their needs and concerns, gather feedback, and learn from their experience; (iii) Consistency: Actions must be consistent to what was said so as to build trust.