

IET Management Symposium 2022
“Extreme Weather Adaptation: Managing Risk for a Resilient Future”
25 November 2022

Adversity’s Adversary

Ir Eric PANG JP, Director, EMSD

1. Introduction

Mr Tse Chin Wan, Secretary for Environment and Ecology, Ir Dr Otto Poon, Symposium Chairman, Ir Dr Hon Lo Wai Kwok, distinguished speakers and guests, ladies and gentlemen, good morning. It is my great honour to join you all in the IET Management Symposium 2022 on “Extreme Weather Adaptation: Managing Risk for a Resilient Future”.

COVID has been the most significant adversity in the past three years. It has become an endemic (風土病) , and the virus is affecting our way of life with relentless mutations over time. Apart from the medical team, engineering professionals are contributing to containing it. Let us acknowledge what the engineering professionals have accomplished: engineers are part of the teams in inventing the vaccine, medical devices, masks, respirators, personal protective equipment, ventilators, etc., to prevent, diagnose and treat COVID.

2. Engineer is a doctor to the crisis of climate change

At the same time, engineering professionals also strive for rapid and large-scale reductions of emissions to keep the goal of limiting global warming to 1.5^o degrees, boost adaptation efforts to deal with current extreme weather disasters and build resilience to address future impacts. Engineering professionals are standing at a pivotal point to be the adversity’s adversary in transitioning to a sustainable environment, a sustainable future, and a sustainable planet.

With the embarkment on transformation to achieve the 1.5-degree goal, Hong Kong has

proclaimed an ambitious pledge to achieve carbon neutrality by 2050. Hong Kong's Climate Action Plan 2050 set out the Government's vision of "Zero-carbon Emissions • Liveable City • Sustainable Development". The action plan outlines four major decarbonisation strategies and measures, namely net-zero electricity generation, energy saving and green buildings, green transport, and waste reduction, for achieving carbon neutrality before 2050.

Engineering professionals play a vital role in attaining carbon neutrality and setting a clear solution path to climate change. We provide scientific and engineering solutions in three aspects: monitoring, resilience and mitigation.

Monitoring

COVID real-time dashboards are utilised to keep us abreast of the latest development. With the addition of sensors for closer monitoring and overseeing the COVID-19 development, the new territory-wide dashboard help us to "Leave Home Safe".

Similarly, advanced-analytics and machine learning help engineers "connect the dots" across people and data to detect and monitor risk comprehensively and cost-effectively. EMSD is fully committed to digitising the government electrical and mechanical assets and facilities through, among others, the innovative Government-wide IoT Network (or GWIN in short). The GWIN enables cost-effective territory-wide remote facility monitoring covering areas that conventional 4G or 5G networks cannot cover, in order to support various innovative applications to improve public service even under the erratic phenomena caused by climate change. The GWIN is a collaborative effort to transform Hong Kong into a resilient and adaptable city.

EMSD collaborates with peer government departments in monitoring rainfall and water level of areas with flooding problems and storm surges. Through data collected by GWIN and big data analytics, we are able to expand the recording and prediction of sea level rise and rainfall arising from climate change. Extreme weather can bring heavy rain which may result in flooding. With the robust and low-cost GWIN network backbone, ultrasonic river and sea water level sensors connected to LoRa gateways can be swiftly and easily

deployed. Currently, remote sensors have been installed at strategic locations covering Shing Mun River, Tai Po River and Heng Fa Chuen. In Shatin, we have installed 47 gateways at various government facilities, including footbridges, government offices, fire stations and water service reservoirs, achieving over 80% outdoor coverage. In Kowloon East, our GWIN comprises 38 gateways covering over 90% of the area. The GWIN's real-time remote monitoring capability also enables us to quickly respond to defective equipment, particularly critical E&M equipment and outdoor facilities that are being impacted by extreme weather.

Resilience

As professionals, we must build resilience to crisis and remain vigilant and prepared for imminent situations.

While fighting the virus, we timely adopt telemedicine, or video medical consultations and telehealth services, across Hong Kong to reduce patient's in person clinical visits. Not only does it save valuable waiting time, the innovative technology effectively wards off outpatients from the risk of viral infections whilst maintaining the operational capacity of hospitals. With this in mind, we shall proactively adjust business continuity plans to suit the evolving nature of our businesses as the crises linger.

Over the past years, the EMSD made remarkable progress in building Regional Digital Control Centre (or RDCC in short), featuring various IT and I&T technologies in open BMS platform, artificial intelligence and big data analytics. The RDCC improves the operational efficiency and environmental performance of government E&M assets on territorially-wide and daily basis, as well as assists us in resource coordination during disaster and extreme weather. The RDCC's operation dashboard enables us to visualise the status and alarms of various designated and widely dispersed sites. The RDCC's energy dashboard also illustrates the energy performance of government buildings. With data analytic engine comprising AI and Machine Learning capability, the energy performance of the building portfolio can be effectively managed and optimised to improve operation and energy efficiency.

During a disaster or extreme weather, the RDCC can monitor the plant conditions of government major venues territory-wide by streaming real-time visual images, together with simultaneous traffic information, in order to better manage resources to maintain the services of E&M infrastructures. Another example of the RDCC is its support to the COVID-19 vaccination programme. The monitoring system provides round-the-clock real-time remote monitoring and fault warning on multiple important information, including that of vaccine freezers, power supply, room temperature, etc. All data are analysed to ensure that the vaccines are appropriately stored and the E&M facilities at the vaccination centres are in good operating condition. The RDCC also provides timely information to facilitate emergency response, including early warnings, personnel contacts and mobile push notifications, giving a complete picture of the operation of each vaccination centre.

In addition to emerging technologies, achieving resilience is also dependent on the behavioural changes of everyone in the community. During the ongoing pandemic, we all must wear masks and adopt hygienic measures continuously. In the same way, to combat climate change, the collaborative effort of the whole community in energy saving is called for. EMSD has been devoting great effort into raising public awareness of energy efficiency by launching several programs, including the “Energy Saving and Decarbonisation for All” and “Energy Smart” campaigns.

In 2021, our "Carbon Neutrality" partners advocated to further deepen and accelerate their pace in pursuing low-carbon transformation, set examples for different sectors in the society and the public, drive the green economy, create more green employment opportunities and promote climate action. The "Carbon Neutrality" partners are encouraged to set their targets and timetables to support renewable energy development, green transport popularisation and waste reduction. Their measures and outcomes are encouraged to be shared with the public to achieve deep decarbonisation. About 70 per cent of the "Carbon Neutrality" partners have set or are planning to set carbon neutrality targets.

In our Energy Smart program under the Green Schools 2.0, subsidies are provided to primary and secondary schools to replace their aged and inefficient E&M facilities to achieve energy efficiency and conservation. The works include replacing existing air-conditioners with variable-speed air-conditioners, converting existing fluorescent lighting

or incandescent floodlights into LED lighting and floodlights, and installing real-time energy monitoring systems. Through these initiatives carried out at schools, we hope that the awareness of energy efficiency and conservation can be transplanted to students by allowing them to visualise the saving achieved.

Mitigation

A step forward in resilience against climate change is to mitigate its influence.

Given that extreme weather is becoming more violent, the number of hot days and hot nights have increased in recent decades. Last year, our Observatory logged a record high of 54 very hot days with 33 deg.C or more, and 61 hot nights with 28 deg.C or more. This year, we were again hit by the heatwave. In July 2022 alone, the Observatory logged 21 very hot days and 25 hot nights. Both of these are record-breaking, and are about three times the climatological normal of the past three decades, from 1991 to 2020. The collaborative effort of engineering professionals shall uphold to combat climate change.

This year, we have launched the Online Building Based Electricity Utilisation Index Benchmarking Tool to accelerate public awareness in improving energy efficiency and changing behaviour. The tool allows building users and management to compare its annual overall electricity utilisation per unit area with the benchmarked buildings so as to unveil its energy-saving opportunities. The tool also provides energy-saving advice for building users, thereby mobilising the community to take collective actions to use energy efficiency.

EMSD provides continuous efforts to mitigate climate change. Numerous low-carbon consumption policies have been launched since the 1990s. However, are these policies sufficient? Given the recent hot weather and abnormal weather phenomena, we should have the same answers in mind.

3. Engineers are inventors

So, what should we do? We, engineers, are inventors to create a better future through innovation and adopting new technologies.

Back to our COVID-19 analogy, we have applied a long list of engineering innovations such as sewage testing for the virus, AI-based Face Mask Detection, AI robotic cleaning and disinfection, Electronic Wristband and Monitoring System for Hong Kong's "StayHomeSafe" Home Quarantine Support Solution, "know Touch" contactless panel for lift control, etc.

Solutions to combat climate change – Solar + Hydrogen

In combatting climate change, engineering innovations and emerging technologies are likewise critical to the success. During the last week, in the COP27 held in Egypt, the theme of the Climate Action Innovation Zone is "Scaling a hydrogen economy through supply chain collaboration". Hydrogen is promoted to store excess renewable energy, which is converted back to electricity by fuel cells or hydrogen-driven turbines when needed. In HK, a preliminary feasibility study is being conducted for a solar-to-hydrogen facility at reservoir, which would generate green hydrogen to power hydrogen fuel-cell driven heavy vehicles. Hydrogen produced using renewables could become a key component in the global zero-carbon future. As renewables grow, we have opportunities to produce and store green hydrogen.

There are in fact many mega-sized Solar to Hydrogen projects in the world under planning or construction. For example, the 300MW Solar to Hydrogen project in Kuche, Xinjiang, is targeted to be completed in 2023. Hong Kong has much potential to follow the global trend to switch to the new hydrogen economy.

Innovations to combat climate change

Technological breakthrough is vital in attaining carbon neutrality. Let me give you some examples.

Heat transmission through building windows lead to significant cooling load. The Intelligent Thermo-responsive Window for Indoor Thermal Management and Energy Saving in Buildings by the CityU can reduce solar heat gain in buildings and thus moderate the indoor thermal environment. Notably, the invention can lower indoor air temperature by over 4°C and save around 7% of energy consumption.

The Radiative Cooling Coating (or RCC in short) developed by the PolyU is a special coating material with broadband infrared emissivity properties that would facilitate heat dissipation from the coated material. When painted on a building envelope, it can achieve a sub-ambient cooling effect for the coated surface in the summer season. The RCC technology is being tested on the metallic roof of a CEDD's site office. The preliminary result indicates that the indoor room temperature was lowered by 1 to 2 degrees Celsius, saving about 5% energy for air conditioning.

As for data centres, EMSD has been striving to explore an effective solution in heat management for data centres. We have applied immersion cooling technology with server components submerged in a thermally, but not electrically, conductive coolant to enhance heat transfer and cooling performance of servers. Up to 50% saving in electricity consumed by the cooling system is recorded.

In driving green innovations and installations, EMSD has developed a web-based Solar Irradiation Map with Solar Energy Calculator for Hong Kong and the Integrated Solar Energy Performance Management System (iSMS) to help the general public widely adopt distributed solar PV and align the strategy of “Net-zero Electricity Generation” of the Climate Action Plan. These two inventions are recognised by the Inventions Geneva 2022 with silver and bronze medals.

More Innovations

The potential of AI in improving building energy efficiency and reducing overall energy consumption in achieving the goal of carbon neutrality cannot be underestimated. Our “Semantic AI on the Building Operation and System Optimization” won a Gold Medal in the International Exhibition of Inventions of Geneva in 2021. The Semantic AI

technology has been applied to forecast cooling demand and equipment performance for optimising settings and controls of air-conditioning systems for energy saving. In its implementation for the chiller control system in West Kowloon Government Offices, the Semantic AI achieved a 99% accuracy in predicting the cooling demand, bringing 10 to 15 % improvement in plant energy performance. Through optimising the operation of E&M facilities, building energy performance could be significantly improved, thus contributing to carbon neutrality.

The EMSD initiated the E&M AI Lab in September this year. The Lab is a data hub and a co-creation platform. It helps accelerate effective sharing and partnerships, with stakeholders from the Government, industry, academia and research institutes, in the application of big data analytics and AI development for E&M facilities of buildings.

We are committed to act as the Innovation Facilitator for the Government to promote the use of I&T in the Government. The EMSD launched the E&M InnoPortal (InnoPortal) in March 2018. With the core concepts of “Connect”, “Share”, and “Co-Create”, we match the needs of government departments and public organisations with the I&T solutions of start-ups, universities and research institutes, promote the application of research and development achievements, and help realise the I&T wishes of our client departments. Up to now, over 1000 I&T solutions, over 400 I&T wishes and over 160 matched I&T projects.

I solicit your support to uphold the same innovative spirit, which would be most useful for combating challenges in our journey ahead.

4. Conclusion

Lastly, I would like to share an idea from our engineering pioneer - Leonardo da Vinci. He classifies people into three types. The first type of people can “see”. They investigate the cause of climate change, explore possible actions for tackling its impact, and educate other people to understand climate change. The second type of people only see what they’re shown and are conditioned to see through others. They respond to extreme weather when it occurs and acts on the issue related to themselves. The last type is those

who refuse to understand what the world is telling them. They rely on others to solve the problem and do not care about the cause and impact of climate change.

Being engineering professionals, we are equipped with the knowledge and experience to investigate and explore possible actions to combat climate change. We see the challenges ahead. Let us join hands to prevent the climate disaster from happening to us, our descendants and humanity.

Thank you very much.