IET Hong Kong Management Symposium 2024

Driving Sustainability from Solar and Wind to Hydrogen

24 May 2024 (Friday)

Hydrogen-fuelled future with peace of mind

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Introduction and Opening

(Slide 1) Good morning, Mr Tse Chin Wan, (Secretary for Environment & Ecology), Ir Henry Cheung (Symposium Chairman), Ir Dr Hon Lo Wai Kwok (Symposium Advisor), honorable speakers, distinguished guests, ladies, and gentlemen. It is my great honor to join this symposium today and have the opportunity to engage with esteemed professionals and experts. We all know that we are now in the revolution era of Artificial Intelligence, and I have to alert you that my presentation slides are "invaded" by AI! I particularly like this first slide, which I can feel relaxed and feel the "Peace of Mind", I hope you would like it!

(Slide 2) The topic of my speech today is "hydrogen-fuelled future with peace of mind". Given its relation to the future, I cordially invite all of you to join me on this transformative journey by taking on this "plane", where we will explore the immense potential of hydrogen as a sustainable fuel and how we can harness this energy source with a profound sense of peace and assurance. So please fasten your seat belts, sit back and relax as we embark on an extraordinary voyage of discovery.

(Slide 3) I'm sure many of you are familiar with the remarkable story of the Wright brothers. These pioneering individuals are credited with inventing the first airplane and achieving a historic flight in 1903, forever altering the course of aviation history.

(Slide 4) However, what you may not know is that the brothers were also tragically involved in the first fatal incident in aviation history in 1908. This heartbreaking event led their father to make a heartfelt request to the brothers, to promise that they would never fly together on the same aircraft, as he fears losing both of his son at once in an aircraft incident. This story underscores the challenges people faced in finding peace of mind when flying in the early days.

(Slide 5) I believe everyone here agrees that "safety" is a key factor in ascertaining "peace of mind". It should come as no surprise that people hesitate to take the first step when they do not feel safe or secure—after all, we are dealing with life and death. As the aviation industry began to soar, people gradually gained confidence in air travel. Concerns about flying were gradually overcome through rigorous maintenance and safety inspections, aviation law and a proven track record of aviation safety. According to data published by International Air Transport Association (IATA)[1], there is only 1 out of 1.26 million chances that you will ever experience an accident when flying. Whereas one person dies in a road accident every 24 seconds around the world, as stipulated in research done by the United Nations[2].

(Slide 6) Likewise, when it comes to hydrogen, its utilization as a fuel source is a relatively novel technology, resembling the early days of aviation when the first airplane was invented. The unfortunate incidents that occurred during the early stages of hydrogen implementation have instilled doubt and caution among individuals, causing them to question and reconsider the viability of hydrogen.

Peace of mind - Safety

Safety through technological advancement worldwide

(Slide 7) Ensuring the safe application of hydrogen fuel is of paramount importance in order to gain public confidence in the application of hydrogen fuel. Hydrogen safety has been boosted with the help of science and technology around the world. Nowadays, one of the most common methods of storing hydrogen is in gaseous form. Hydrogen is compressed to and stored in tanks designed to withstand high pressure and not rupture under extreme conditions.

(Slide 8) For instance, these tanks are required to undergo comprehensive and extensive testing. Let's first watch the video in the middle, which shows one of the standard tests, the Penetration Test. The Penetration test is to shoot the tank with gun bullets to prove the integrity of the tank, and we can see from the video that the tank does not rupture after the shot. Next, we can witness the Bonfire Test on the left. The bonfire test is an important prototype test to assess the safety performance of the tank. The tank is being heated up to

[1] https://www.iata.org/en/pressroom/2024-releases/2024-02-28-01/
[2] https://www.un.org/sites/un2.un.org/files/media_gstc/FACT_SHEET_Road_safety.pdf

at least 590 degrees Celsius, all the hydrogen should be vented out via the safety device at the same time. Lastly, we have the Impact Damage Test on the right. The tank shall not leak or rupture after being dropped at a height of 1.8 m. Results from these tests will demonstrate if the tanks meet the rigorous standards and regulations set forth by regulatory bodies.

(Slide 9) As for hydrogen filling stations, they have been equipped with a wide range of crucial safety measures that are designed to cope with multiple fault situations. For example, hydrogen detectors are installed at various locations of the stations and interlocked with an emergency shut-off system. The hydrogen system can be activated in a few seconds' time upon detection of hydrogen leakage. Under the circumstances that extreme high pressure is accidentally built up inside the hydrogen system, pressure relief valves are in place to release hydrogen through a dedicated vent pipe and disperse it to the air at a high level. Fire walls are also required to be erected in stations to protect the public and station personnel in case of hazardous hydrogen events. The latest advancements in technology, materials, design, and manufacturing techniques in the field of hydrogen have paved the way for the development of safer and more reliable options.

Safety through code of practice & technical guideline

(Slide 10) Other than the safety in design, it is vital to recognise the highly flammable nature of hydrogen and exercise caution on implementation. This highlights the significance of establishing a robust framework to govern the safe utilization of hydrogen. The Government has established an Inter-departmental Working Group on Using Hydrogen as Fuel (i.e. the Working Group) two years ago, consists of thirteen government policy bureaux and departments. The Working Group is responsible for promoting the local implementation of hydrogen energy and overseeing various trial projects to ensure their safety.

(Slide 11) So far, the Working Group has reviewed and given agreement in principle to a total of 14 valid hydrogen energy trial applications, encompassing areas such as hydrogen fuel cell double deck buses, hydrogen filling stations, hydrogen transportation in bulk and electricity generation from hydrogen fuel cell, etc.

(Slide 12) Our department has been providing professional support in terms of technical and safety expertise to assist the Working Group in examining applications for hydrogen

as fuel trial projects in Hong Kong. EMSD, being the Gas Authority in Hong Kong, has extensive experiences in gas safety regulation from the enactment of Gas Safety Ordinance (Cap. 51) on LPG, Towngas, and Natural gas over the past few decades. EMSD, after consulting the trade, has published three important documents including the code of practice for hydrogen-fuelled vehicles and maintenance workshops, code of practice for hydrogen-refuelling stations, and guidance notes on quantitative risk assessment study for hydrogen installations.

(Slide 13) These guidelines have been applied in trial projects on hydrogen fuel conducted in Hong Kong, including the first hydrogen fuel cell bus already running on the roads in Hong Kong since the end of February this year and the first hydrogen fuel cell street washing vehicle and public hydrogen-filling station in Yuen Long Au Tau expected in Q3 this year.

Safety through legislation amendments to Cap. 51

While the approval of different hydrogen as fuel trial projects is still underway, the work to safeguard the general public on the use of hydrogen as fuel continues.

(Slide 14) To address the need for a comprehensive regulatory framework to govern the safe use of hydrogen fuel, a benchmarking study has been conducted to examine the regulatory frameworks of using hydrogen as fuel in various countries and regions such as China, the United Kingdom, Japan, the United States, and South Korea. The findings reveal that currently there are lack of comprehensive regulations specifically addressing the use of hydrogen as fuel around the world, because the regulatory regime relies heavily on numerous technical standards, rather than a solid and comprehensive framework.

(Slide 15) Like I mentioned before, the Gas Authority has effectively regulated LPG, Towngas, and Natural gas for over 30 years through the implementation of the Gas Safety Ordinance, Cap. 51. This comprehensive Ordinance governs the entire gas supply chain, encompassing importation, manufacturing, storage, transportation, supply, and usage of gas with a strong focus on safety. The successful application of the Ordinance is evident in the LPG vehicle scheme for taxi and mini-bus, where it regulates LPG suppliers, fuel systems on LPG vehicles, as well as the operations of LPG filling stations. Considering the similarities between regulating the complete end-to-end value chain of hydrogen fuel and the gases currently regulated under the Gas Safety Ordinance, coupled with the

proven track record of gas safety in Hong Kong, it is deemed that the Gas Safety Ordinance provides the most suitable legislative framework for effectively regulating the safe use of hydrogen as fuel in Hong Kong. We believe with all the measures taken in place, every citizen in Hong Kong is assured the "safety" of using hydrogen as fuel.

Peace of mind - Security

(Slide 16) While "safety" is crucial, it alone is not enough to achieve true peace of mind. Feeling secure requires more than simply addressing safety concerns.

(Slide 17) It is essential to have control in our own hands and minimize reliance on external factors. This is where the concept of "Security" comes into play.

(Slide 18) Drawing a parallel to the high-speed rail example, China has successfully built a world-leading high-speed rail system with independent intellectual property.

(Slide 19) It stands as the only country in the world with commercially operated high-speed rail trains capable of reaching speeds up to 350 kilometers per hour with the world's longest and most extensively used high-speed rail network, with a total length exceeding 45,000 kilometers as of 2023. This is equivalent to almost 3 times the total length of Japan and most European countries, including Spain, France, Germany, Italy, and UK, added together. China's high-speed rail also has a renowned punctuality rate of over 95%.

Secure energy sources

This is precisely the outcome we aspire to achieve for the application of hydrogen in Hong Kong.

(Slide 20) Fortunately, our city enjoys advantageous geographical proximity to China's southern Guangdong Province, which provides ample hydrogen supply, particularly as a by-product of chemical plants. Hydrogen can be efficiently transported from Mainland China to Hong Kong via tube trailers on roads, with a travel time of approximately two hours which lies within an economically feasible delivery distance. To enhance collaboration in hydrogen development between Mainland China and Hong Kong, the EMSD has been working closely with the State Administration for Market Regulation (國家市場監督管理總局). A Memorandum of Cooperation (MoC) is being prepared to foster information and technology exchange on the regulatory framework and

standardization of hydrogen applications to facilitate hydrogen development. Given Mainland China's leading position in hydrogen supply around the world, meetings with the three major oil and hydrogen supplies companies in China, namely Sinopec Limited, China National Offshore Oil Corporation and PetroChina Company Limited, had been conducted to strengthen cooperatives relationship.

(Slide 21) In terms of local supply, Hong Kong and China Gas Company (HKCG), Towngas, the primary supplier of piped gas in the city, has successfully tested the extraction of hydrogen from its gas supply network. Town gas network covers more than 85 percent of households and businesses in Hong Kong, reaching virtually every corner of the city. On-site production of hydrogen from solid waste or by electrolysis is also under development to increase local hydrogen supply source. Hydrogen can then be conveniently tapped directly at hydrogen filling stations, facilitating the refuelling of hydrogen vehicles. This approach significantly saves time and effort in building a separate hydrogen supply infrastructure.

(Slide 22) Other countries, which do not have the privilege of having ample hydrogen supply internally, have also found ways to maintain stable hydrogen supply and this is how the world's first liquefied hydrogen carrier ship came up in 2021 for the transportation of liquefied hydrogen from Australia to Japan. International trading of hydrogen from low-cost production areas to high-demand areas is expected to have a promising growth in the coming decades to cover the "security" of hydrogen.

Peace of mind - Sustainability

(Slide 23, 24) Hong Kong, alongside the collaboration with Greater Bay Area as mentioned before, can certainly develop our own hydrogen standard or hydrogen business. However, is this good enough to achieve the peace of mind?

(Slide 25) Do we want our next generation to enjoy what we are enjoying now? Indeed, the ultimate factor that gives everyone the "peace of mind" is "Sustainability" in the long run. That "peace of mind" is building on the confidence that something can exist and develop without depleting our natural resources and that will not be exhausted in the future.

Sustainable green hydrogen production

Hydrogen sustainability involves the production of hydrogen using renewable energy which is also known as green hydrogen. According to the Hydrogen Council, global capacity of 700MW for green hydrogen production through water electrolysis was deployed by the end of 2022[3].

(Slide 26) China is currently the leader for green hydrogen production through electrolysis with the installed capacity at about 300MW from Xinjiang production plant. China's first 25MW off-grid hydrogen production project using wind power was also put into operation in Liaoning April this year. Though we may not be able to see windmills in Hong Kong very soon, various technologies for producing green hydrogen using solar energy for electrolysis and waste to hydrogen are indeed being explored in Hong Kong.

(Slide 27) For instance, we are exploring how to collect the maximum solar energy for the electrolysis. Apart from the traditional solar panels installed on the building roofs, we are working to collect solar energy from the huge surface area of reservoirs. Pilot projects of floating solar panels installation at reservoirs have been implemented in Hong Kong since 2017. With the large-scale green electricity generated, there is a possibility to convert excess electricity for green hydrogen production and transmit to other hydrogen infrastructures within Hong Kong.

(Slide 28) We are also very delighted to learn that trial project applications for green hydrogen production from solid waste in Hong Kong have been submitted to the Inter-departmental Working Group recently. The solid waste will undergo steam methane reforming or gasification technology to generate green hydrogen. It is anticipated that the green hydrogen production rate could go as high as 4000 kg per day in the early stage of implementation. The total amount of green hydrogen produced would be sufficient to operate 160 nos. of hydrogen fuel cell double deck buses and 150,000 kg of carbon dioxide emission could be saved from the switching of diesel double decker to hydrogen fuel cell double decker in this case with similar energy consumption[4].

Sustainable planning on new development areas

(Slide 29) Another area the Government is presently focusing on with relation to the

[3] https://hydrogencouncil.com/wp-content/uploads/2023/05/Hydrogen-Insights-2023.pdf
[4] https://www.hydrologiq.com/generator-emissions-calculator/

sustainability of hydrogen is long-term land-use planning integrated with hydrogen infrastructures. Numerous energy stations for hydrogen vehicles refuelling in the New Development Areas are anticipated in future. In fact, the Government has already announced to issue the hydrogen strategic plan in next month, which will establish a clear policy framework for the advancement of hydrogen initiatives in Hong Kong for the near future. I believe we will have more insights on hydrogen development in Hong Kong by then. Again, this AI-generated Slide is even better than the first landing page Slide, with solar energy to be harvested on the roof of the station too!

Sustainable power generation

(Slide 30) Other than hydrogen production, the Government is exploring additional suitable application scenarios for hydrogen in Hong Kong, e.g. assessing the feasibility of utilizing hydrogen in electricity generation, either in large scale at power plant or small scale at construction sites or ports, where it can potentially offer cleaner and more sustainable energy solutions. The Government see the potential of using hydrogen for electricity generation, and certainly so do the power supply companies in Hong Kong.

(Slide 31) We understand that CLP and GE have already signed a memorandum of understanding agreement to jointly develop a decarbonization roadmap, there is potential that hydrogen could be imported from Hainan through subsea pipeline, blended with natural gas and supplied to CLP's gas-fired power generation facilities in Hong Kong. HK Electric is also actively exploring opportunities to deploy advanced zero-carbon energy solutions such as hydrogen. Utilizing hydrogen to generate electricity effectively and efficiently would be the goal in achieving carbon zero and combatting climate change in the long run.

Closing

(Slide 32) As we progress through the three S - "Safety", "Security" and "Sustainability" in this journey, I hope you can truly gain confidence and find peace of mind when considering the utilization of hydrogen as a fuel in the future. Undoubtedly, safety will be the most critical aspect that we must address to alleviate the fears and concerns that many of us may have regarding its development. Without instilling a deep sense of trust and confidence in the public regarding use of hydrogen, our progress towards a hydrogen-fuelled future will certainly be hindered.

However, addressing safety concerns alone is insufficient; without guaranteeing security, there will be hesitations in adopting this energy source, which could have a significant impact on our reliance on hydrogen in the future. While safety and security are of equal importance, true peace of mind cannot be achieved without long-term sustainability. We must strive for breakthroughs in technology, embracing a "New Quality Productivity Force" in the hydrogen industry, in order to increase productivity and work towards a greener future.

(Slide 33) By addressing these critical factors, we can unlock the true potential of hydrogen just like this transformative vision, where we can truly experience a profound sense of peace of mind, embracing a hydrogen-fuelled future not only “safe” and “secure” but also “sustainable” for generations to come. Thank you very much!

(~3000 words)