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Editorial

The Road to Green Mobility in Hong Kong

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Green mobility is in high demand in the 21st century. The rapid growth of modern cities has led to increased transportation, which has resulted in heavy traffic, scarcity of fossil fuels and growing environmental problems. Therefore, vehicle emissions should be controlled and reduced with the use of emerging cleaner technologies [1]. Hybrid vehicles (HVs) have been developed to reduce the use of internal combustion engines (ICEs) by incorporating them with electric motors. By reducing carbon and other polluting emissions, electric vehicles (EVs) have a positive impact on the environment. The development of near-zero-emission vehicles is currently a considerable challenge. EVs fueled by renewable energy such as hydrogen can be a feasible choice since they emit only natural byproducts such as water rather than combustion gases, which are not detrimental to air quality and population health.

With the advent of battery electric vehicles (BEVs), the issue of greenhouse gases (GHGs) has been partly addressed. BEVs are zero-emission vehicles that are powered entirely by electricity from batteries. BEVs, however, do not radically reduce GHG emissions since the electricity is mostly generated by thermal plants [2]. BEVs have their own drawbacks, such as limited driving range, long battery charging time, and battery safety concerns. The automobile industry thus developed fuel-cell electric vehicles (FCEVs), which have received extensive attention recently. FCEVs are powered by electric motors that receive power from a fuel cell. Hydrogen combined with oxygen from the air is the main energy mover in FCEVs. Fuel cells have a number of benefits, including clean fuel, high efficiency, no harmful emissions, and low acoustic noises. Plug-in fuel cell hybrid electric vehicles and fuel cell range extender electric vehicles also attract much attention [3,4].

A startup system is needed when using a fuel cell as the sole power source for an EV. Hence, automakers developed fuel-cell hybrid electric vehicles (FCHEVs), which are powered by a fuel cell and either one or more auxiliary power sources (such as batteries and supercapacitors). The Daimler Mercedes Benz F-Cell, GM Chevrolet Volt, Toyota FCHV, and Honda FCX are all hybrid electric vehicles (HEVs) with an energy configuration of fuel cell + battery. Since the energy feed for FCHEVs alternates between fuel cell and auxiliary power, a reliable energy management system (EMS) is needed to distribute power between the fuel cell and auxiliary power based on the vehicle's operating mode or power demand. A successful EMS not only guarantees the normal operation of vehicles, but also improves efficiency, resolves physical constraints, prolongs service life, and realizes a comprehensive fuel economy.

At present, the government of Hong Kong Special Administrative Region of China (Hong Kong SAR) has not yet issued an up-to-date hydrogen energy strategy. Despite the drawbacks of current policies, research institutions and enterprises in Hong Kong have been committed to developing hydrogen mobility to realize carbon neutrality and green transportation. Recently, the Hong Kong Productivity Council (HKPC) launched Hong Kong's first fuel cell commercial EV—the hydrogen-powered forklift with a hybrid fuel cell and battery system, as shown in Figure 1. At present, electric forklifts with

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lead–acid and lithium batteries commonly used in the industry present problems such as health and environmental safety hazards, a long charging time, high costs and unstable energy efficiency. Hydrogen is a zero-emission clean fuel. The project has integrated the hydrogen fuel cell hybrid system into the forklifts, successfully overcoming the problems of traditional electric forklifts and providing a cleaner and more eco-friendly solution, demonstrating a broad application prospect. The hybrid system uses hydrogen fuel cells to maintain the sustainable and stable operation of electric forklifts, while its hydrogen refuelling program only takes 3 min, greatly reducing the downtime of the forklift. The equipped lithium battery can provide additional power for the forklift to accelerate, climb and lift heavy objects. Even if the fuel is exhausted, the forklift is still able to drive to the hydrogen refuelling station to refuel by using electricity. It is reported that this developed hydrogen fuel cell hybrid system can also be adapted to different tonnages and types of electric forklifts.

Figure 1. (**a**) Hong Kong's first hydrogen-powered forklift launched by HKPC. (**b**) The fuel cell hybrid system inside.

Furthermore, HKPC proudly announced that its R&D project named "High Efficient Hydrogen Fuel Cell Hybrid System for Electric Forklifts" received the Best Demonstration Project Award at the "2022 Hydrogen 20 International Hydrogen Energy Industry Summit–International Hydrogen Sky Award" ("Hydrogen Sky Award"). The Project is jointly developed by HKPC and Startec Limited. It is also funded by the Innovation and Technology Fund of the Innovation and Technology Commission of the Hong Kong government through the application support by the Automotive Platforms and Application Systems R&D Centre (APAS). This "Hydrogen Sky Award" is a global selection activity directed by the China Association for Science and Technology, and co-organized by the World Green Design Organization and the Hydrogen 20 Summit Organizing Committee, representing the highest honor in the global hydrogen energy industry. Receiving the first "Hydrogen Sky Award" is an important recognition of Hong Kong's green mobility development. The Citybus, Hong Kong's leading franchised bus operator, launched Hong Kong's first hydrogen-powered double-decker bus in late June, 2022. The fuel cell hydrogen bus is also fitted with a 450 kWh lithium–ion battery, and its hybrid system is reported to have a range of up to 200 km.

The Chinese central government plans to increase the number of hydrogen fuel cell vehicles to around 50,000 by 2025. In 2020, the scale of FCHEVs in mainland China reached about 10,000, and commercial applications have initially been realized in engineering vehicles and bus fleets in some cities. Compared with the development of hydrogen energy in other parts of China, Hong Kong, which has economic advantages, is far behind in terms of green mobility. Although efforts have been made in Hong Kong in the technical field of green transportation, the practical application and development of hydrogen energy technology in Hong Kong is still subject to many constraints due to the lack of clear legal support. One of the top priorities for the Hong Kong government in the future is to establish

a practical legal framework for hydrogen energy that meets the needs of green mobility in the city. With the support and guarantee of policies and laws, Hong Kong is expected to open up new possibilities in terms of green mobility.

The Guest Editors hope that this Editorial and this Special Issue "Trends and Emerging Technologies in Electric Vehicles" will draw the attention of researchers, technologists and government officials in Hong Kong and other parts of the world still plagued by highly polluting mobility.

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