

- Case Study -

Clean energy vehicles at the Beijing Winter Olympics



**Sustainable
development
goals (SDGs)**

Goal 12: Responsible consumption and production

Goal 13: Climate change



**Relevant concept/
issues**

Renewable energy



Relevant sector

Transportation

Environment issue: Carbon emissions on the roads

Carbon emissions from transportation amounted to 11% of the total annual carbon emissions in China in 2019, which is equivalent to approx. 10 billion tons of carbon dioxide. 86.76% of transport carbon emissions came from the roads, and included heavy trucks, buses, cars and other vehicles (Li et al., 2021). Due to the increase in domestic automobile ownership in China, carbon emissions by transportation are an increasing challenge to carbon reduction, therefore trucks and passenger cars are the key focus of energy conservation and emissions reduction across the entire transportation industry.

Solutions: Clean energy vehicles

Clean energy vehicles are commercial vehicles powered by renewable energy rather than petroleum; they are also called new energy vehicles (NEVs) in China. In terms of battery types, NEVs can be divided into hydrogen fuel cell vehicles and chemical battery vehicles. Hydrogen fuel cell vehicles use compressed hydrogen as fuel to generate the electric drive motor rotation by reacting with oxygen in the battery (Liu, 2019). Chemical battery vehicles use different forms of lithium batteries as energy storage units to drive the power system of the vehicle by charging and discharging the battery.

In recent years, Chinese government departments have vigorously promoted the application of new energy vehicles and formulated a series of goals to support and promote the realization of energy conservation and emissions reduction targets for transportation. China's "14th Five-Year Plan" has a clear focus on improving the proportion of urban green transportation. It is proposed that pure electric vehicles will become mainstream new sales vehicles, and vehicles in public areas will be fully electric.

Challenges of clean energy vehicles

Challenges from promoting, or replacing, conventional vehicles with clean energy vehicles are mainly related to the technology limitation of car batteries and the availability of charging centers.

There are still some problems in terms of the development of battery technology for clean energy vehicles, such as the development of the powertrain system and electronic control system. The charging technology needs to be optimized and improved urgently. There are also some problems with battery technology, such as energy density, power density, working range, life cycle and service life. The safety of the battery system is insufficient, and reliability does not meet requirements so the practicability is low and cost is high (Luo, 2022).

On the other hand, the lack of a relatively complete network of charging facilities in various regions, combined the lack of a sufficient number of charging facilities with standard specifications and good performance, means it is difficult to meet the needs of new energy vehicles to supplement energy (Luo, 2022).

Application: clean energy vehicles at the 2022 Beijing Winter Olympics

Beijing 2022 Winter Olympics committed to host the greenest and cleanest Olympic Games ever. It proposed 18 measures to reduce carbon dioxide emissions in guiding its endeavors towards achieving a carbon neutral game, and one of these was low-carbon transportation.

During the event, more than 1000 hydrogen fuel cell vehicles and 30 refueling stations were being used for the games. Each single bus could reduce carbon dioxide emissions by 11.8 metric tons over a distance of 10,000 kilometers, as these vehicles only emit pure water. At the end of the event, more than 880 hydrogen-powered buses were operating in Zhangjiakou, the co-host city, and they services nine routes. The vehicles covered a total distance of 20 million kilometers. The application of new energy vehicles is expected to reduce about 11,000 tons of carbon dioxide emissions, which is the equivalent to carbon sequestration of more than 30 square kilometers of forest in a year.



Fig. 1. Fuel Cell Bus at the 2022 Beijing Winter Olympic.



Fig. 2. CEV coverage in Beijing 2021. Source: Renmin.com

Source: Wu, C., 2022. Beijing 2022 Winter Olympics set to become first Olympic Games fully powered by green energy. [online] Hb.dzcom. Available at: <http://hb.dzwww.com/p/p6iCC1IBC6.html> [Accessed 21 November 2021].

Reference:

- Li, X., Tan, X., Wu, R., Xu, H., Zhong, Z., Li, Y., Zheng, C., Wang, R. and Qiao, Y., 2021. Paths for Carbon Peak and Carbon Neutrality in Transport Sector in China. *Chinese Journal of Engineering Science*, 23(6), p.15.
- Liu, H., 2019. Technology and Development of Hydrogen Fuel Cell for Vehicles. *SHANGHAI ENERGY CONSERVATION*, 08(2019), pp.674-678.
- Luo, Z., 2022. China's New Energy Vehicle Industry and Technology Development Status and Countermeasures. *Automobile Applied Technology*, 1(5), pp.158-162.
- Wang, Y., 2022. Video: Hydrogen vehicles fuel Beijing Winter Games. [online] Govt.chinadaily.com.cn. Available at: <https://govt.chinadaily.com.cn/s/202202/18/WS620f0963498e6a12c121f5e1/video-hydrogen-vehicles-fuel-beijing-winter-games.html> [Accessed 18 February 2022].
- Wu, C., 2022. Beijing 2022 Winter Olympics set to become first Olympic Games fully powered by green energy. [online] Hb.dzcom. Available at: <http://hb.dzwww.com/p/p6iCC1IBC6.html> [Accessed 21 November 2021].
- Zheng, X., 2022. Clean energy vehicles take road to future at the Winter Olympics. [online] Chinadaily.com.cn. Available at: <http://www.chinadaily.com.cn/a/202202/09/WS6202fa2ea310cdd39bc85717.html> [Accessed 9 February 2022].