

# Proposals for Advancing Hong Kong to Carbon Neutrality by 2050

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**Abstract:** Extreme weather events caused by climate change will affect global human safety, so reducing carbon emissions is one of the work centers of all countries in the world. To help HK achieve carbon neutrality by 2050, this paper analyzes the current status of carbon emissions and finds that the work is mainly focused on three parts: power generation, transportation and waste management. Hydrogen will play an important role in solving the technical and environmental problems of power generation and transportation for a long time to come. This paper suggests that HK should introduce green hydrogen energy for power generation and promote hydrogen energy fuel cell electric vehicles when the time is ripe. And in the waste management industry, promoting extended producer responsibility (EPR) and education promotion for better waste reduction and upcycling.

**Keywords:** Carbon Neutrality; Net-Zero, Green Hydrogen Energy; Green Transportation; Waste Reduction

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## 1. Introduction

In 2020, HK announced that it would strive to achieve carbon-neutral before 2050. It suggested that achieving carbon neutrality requires the joint efforts of the government and the public, and called on major enterprises to increase the speed and depth of investment in low-carbon transition and jointly implement climate action (GovHK News, 2021).

Carbon neutral is a state of net-zero carbon dioxides emissions. Mitigate or offset carbon emissions from human activities by replacing fossil fuels, purchasing renewable energy certificates and carbon trading (European Parliament, 2019). The term "net-zero" is also increasingly used to describe a more comprehensive commitment to decarbonization and climate action, which would help limit carbon concentrations and global temperature increases, and reduce the risks and damage caused by climate change.

In order to effectively implement the actions and achieve carbon neutrality as soon as possible, the government (2021) has released *Climate Action Plan 2050*, which sets out the vision of "Zero-carbon Emissions · Liveable City · Sustainable Development" (p.4). Based on the current status of carbon emissions, this paper mainly discusses technologies and policies related to power generation, transportation and waste management to help this area achieve its carbon neutrality target by 2050.

## 2. Status of Carbon Emissions

In 2019, electricity generation is the largest source of carbon emissions in this district, accounting for about 66%, followed by transportation (about 18%), waste (about 7%, mainly from landfills), other fuel consumption (about 5%) and industrial processes and product use (GovHK, 2021). Specifically, natural gas has gradually replaced coal in power generation fuel mix, accounting for 24% of the total, but remains the most carbon-emitting fuel in the mix (Figure 1). Then, there are about 660,000 private cars in the whole city, which have the highest carbon emissions among all vehicles (Figure

2). And waste ranked third in total carbon emissions in 2019, with more than 90% of waste coming from landfill decomposition (GovHK, 2021). Therefore, the most direct and effective way to reduce carbon emissions is to develop new zero-carbon energy to replace fossil fuels for power generation, promote new-energy electric vehicles and formulate appropriate regulations to reduce waste and recycling.

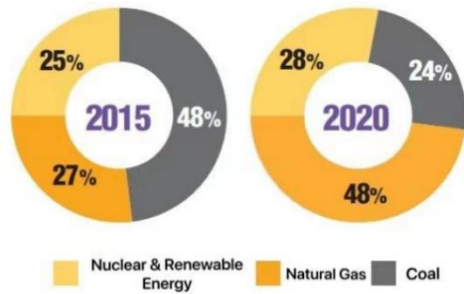


Figure 1 Power Generation Fuel Mix

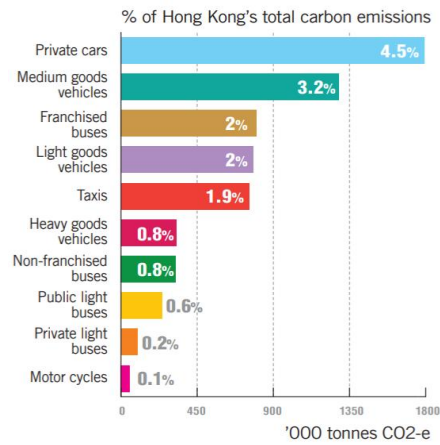


Figure 2 2019 Carbon emissions from vehicles

### 3. Discussion

#### 3.1 Zero carbon power generation - Green hydrogen energy

Power generation in HK needs to be focused on because it is the largest source of carbon emissions, occupying more than half of all emissions. In order to reach net-zero carbon power generation by 2050, sustainable development of renewable and clean energy is required, and replacement of the traditional energy mix in the future. At present, the clean energy sources used are solar, wind and nuclear. However, considering this area's spatial constraints (hilly terrain, dense population and scarce land resources), the construction of large-scale power stations requires additional land, coupling with the unstable energy efficiency of renewable energy sources, making it difficult to use solar and wind energy as the main facilities for direct power generation.

Hydrogen is a clean, safe energy carrier that can be used as a fuel for electricity or as an industrial feedstock, making it ideal for HK, which is in the midst of an energy transition. According to greenhouse gas emissions, hydrogen is divided into green, blue and gray hydrogen, and green hydrogen is regarded as the ultimate clean energy that does not produce any greenhouse gases and is also the core power source of future society (Nair, 2021). It plays a vital role in the decarbonization and energy transition of power generation. Green hydrogen development efforts are increasingly important both technically and economically, whatever in developed or developing countries. According to Goldman Sachs (2020) estimates, the global green hydrogen market will reach \$11 trillion by 2050.

##### 3.1.1 Stability of supply and demand

The power sector's primary concern is balancing power supply and demand, whether during the day or night, winter or summer. Hydrogen has several advantages in this regard. It has no greenhouse gas emissions, can be deployed on a large scale, and ensures the efficiency and flexibility of the entire energy system simultaneously, which could compensate for the erratic efficiency of solar and wind power. First of all, valorizing of excess electricity. Electrolysis converts excess electricity into hydrogen when there is an oversupply, which can be used to provide backup electricity in times of shortage, as well as in

other sectors such as transportation and housing (Hydrogen Council, 2017). What's more, hydrogen can be used as a long-term, carbon-free energy storage carrier, solving the power capacity problems of batteries and supercapacitors, as well as the time span required for their seasonal imbalances (Hydrogen Council, 2017). The growing share of renewable energy is accelerating the deployment of hydrogen as a long-term, global energy storage solution. At that time, the cost of producing green hydrogen will become economically reasonable, with hydrogen stored in salt caverns expected to fall to 140 Euros per megawatt-hour by 2030 (Hydrogen Council, 2017).

### **3.1.2 High transmission efficiency of hydrogen grid**

Long-distance transportation on the grid results in partial loss of electrical energy, but hydrogen can be transported almost 100% efficiently by pipeline (Pellow et al., 2015). This advantage makes hydrogen an economically and technologically attractive new option for large-scale, long-distance transport. Due to cost and technical constraints, the practical application of gas grids to transport hydrogen has not been largely realized worldwide. However, according to estimates from the Fuel Cell and Hydrogen Energy Association (FCHEA) (2021), liquefaction and transportation costs are expected to fall by 30 to 40 percent over the next 15 years, resulting from the continued increase in hydrogen flows. Thus, the government should pay close attention to and participate in developing green hydrogen and hydrogen grid, and seize the opportunity to introduce the technology to this district once it is mature.

## **3.2 Green transportation- Popularity of electric cars**

The popularity of electric vehicles in HK has achieved initial success. According to statistics from the first half of 2021, there is one electric car in every five newly registered private cars (GovHK, 2021). Most of these electric vehicles are efficient hybrid vehicles, like hybrid electric vehicles (HEVs) and plug-in hybrid electric vehicles (PHEVs), which have already reduced their carbon emissions by a significant amount. Nevertheless, achieving green transportation that is completely decarbonized requires the introduction of zero-emission vehicles, such as hydrogen-powered fuel cell electric vehicles (FCEVs). Compared with the former, the latter one new energy vehicles not only emit no tailpipe emissions (except water vapor), but also promote the improvement of air quality and reduce urban noise. When hydrogen is produced by electrolysis using solar or wind energy, carbon dioxide emissions are eliminated over the entire life cycle. Given the above advantages, FCEVs are crucial for the decarbonization of private cars, public buses, medium or heavy-duty trucks, rail and marine transportation in the future.

## **3.3 Waste reduction & circular economy**

Waste reduction is also one of the key targets of carbon reduction. To achieve carbon neutrality, this district needs to establish a circular economy to manage waste. The circular economy is a mode of production and consumption that involves recycling, repairing and reusing existing materials and products for as long as possible, extending the life cycle of products (European Parliament, 2015). This process means minimizing the waste and creating more value. Achieving this goal requires the government, business and the public to work together to realize environmental transformation. Firstly, government intervention is essential, which needs to issue relevant regulations to push enterprises and citizens to reduce waste and recycle compulsively. Next, companies should support public recycling and material management, undertake extended producer responsibility (EPR), increase the design of environmentally friendly products. (OECD, 2021). Finally, citizens lessen the use of disposable goods, take the initiative to separate waste and recycling.

### **3.3.1 Plastic containers EPR**

Plastic is a major source of carbon emissions from landfills. They stay in the environment for a long time, are difficult

to degrade and affect marine ecosystems when they drift into the ocean. Many countries are reducing their use of plastic products. The suggestion is that the government should fully implement the EPR scheme for plastic containers, so that material suppliers, producers and other stakeholders share financial and environmental responsibility for plastic waste management. This will not only reduce the burden on municipalities and increase end-of-life plastic collection and recycling, but also encourage manufacturers to design products that are resource-efficient and have low environmental impacts (WWF, 2021).

### **3.3.2 Education promotion**

Publicity campaigns on waste reduction and recycling are also essential. The government can spread the information on waste reduction and recycling to residents in various communities, or reach out to people of different ages through social media platforms, encouraging them to practice green living and getting the concept of waste reduction into people's minds. In addition, the government can cooperate with primary and secondary schools to strengthen the education and popularization of circular economy in reducing, reusing and recycling (3Rs) during waste management. In short, let waste reduction become a new "Green culture" in this region.

## **4. Conclusion**

As a member of the world, HK must take action to reduce carbon emissions and protect the well-being of future generations. Its efforts to achieve carbon neutrality focus on carbon reduction in the power generation industry and transportation. Green hydrogen, known as the core of renewable energy, can be introduced into this region because of its stable supply, long-term storage, efficient transportation and no greenhouse gas emissions. It can also be used as the raw material of FCEVs to ultimately achieve zero-emission green transportation. Besides, waste reduction is also very important. The government can implement the EPR scheme to share responsibility with stakeholders to extend the life cycle of products, improve recycling efficiency and achieve waste reduction. Plastic containers with the highest carbon emissions could first be used as a pilot, and then gradually extends to all types of solid waste. And education promotion should not be neglected either, which helps to keep the concept of waste reduction firmly in everyone's mind.

Achieving carbon neutrality by 2050 is both a challenge and an opportunity. The chances for economic and social development, including diversified green finance, technological innovation and cross-regional cooperation, will enhance HK's advantages as an international city. It needs to seize the opportunity of this social transformation to reach carbon neutrality early, and create a golden age for the young generation.

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