IMPROVING HONG KONG's AIR QUALITY: TRANSPORTATION POLICY AND INFRASTRUCTURAL ISSUES

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ABSTRACT

Deteriorating air quality is a problem in most Asian cities, and its improvement in Hong Kong was identified as a priority issue in the recent policy address by the Chief Executive, Mr. Tung Chee-Hwa. The dominant cause of air pollution in downtown streets is vehicular emissions, particularly from diesel-fuelled buses, taxis and trucks. It is proposed in this paper that such traffic be greatly reduced in specific urban areas by policy actions, such as terminating bus routes at peripheral interchanges and creating pedestrian malls, and by providing both incentives, namely improved electric public transportation infrastructure, and disincentives, including time-sensitive road pricing for vehicles. Technologies for electric transport are briefly reviewed, and it is concluded that an elevated unidirectional loop system, integrated into the urban fabric, could be operationally effective as a means of decreasing air pollution in Hong Kong.

1. INTRODUCTION

"Record air pollution smothered Hong Kong in a blanket of haze yesterday. Sunlight, the calm before an approaching typhoon and vehicle exhausts were blamed for the poor conditions, which prompted warnings for people with heart or breathing problems to stay inside" [1].

Pollution. By its various intrusions, we can see it, smell it, taste it, touch it and hear it. It creates a health hazard and degrades the quality of life for residents. It is a major problem for most Asian cities. In Hong Kong, our citizens and visitors are becoming increasingly vocal about the quality of air in urban areas and the environment in general, including noise, water pollution and garbage accumulation. There is concern that the worsening situation will slow down the rate at which Hong Kong recovers from the downturn in the Asian economy, effecting Hong Kong as a business centre and a tourism destination. We need to seek ways and means to improve the environment.

2. AIR POLLUTION

Hong Kong has two air pollution problems [2]:

- Acute street level pollution in downtown areas, caused mainly by the intensity of vehicle use in the dense urban environment. Fig. 1 shows the correlation between the

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concentration of respirable suspended particulates (RSP) and the hourly traffic flow over a diurnal cycle [2].

- Visible ambient air pollution, caused largely by Hong Kong sources, but also affected by southerly air flow from Guangdong province in mainland China. Fig. 2 shows the deteriorating situation by tracking the annual number of days of poor visibility over the past eight years [2].

Air pollution in Hong Kong is caused by emissions from both fixed and mobile sources and includes suspended particulates (52% from vehicles), NOx (33% from vehicles), SO2 (7% from vehicles), CO, ozone, volatile organic compounds, and lead. Vehicular emissions are a major source, particularly at street level in urban areas. Diesel engines are a particular problem - over 30% of Hong Kong vehicles are powered by diesel, and such vehicles presently account for 70% of all vehicle-km travelled each year [2].

Fig. 1  Hourly variation of RSP and traffic flow at a typical urban location in Hong Kong (1997) [2]
Fig. 2 Number of days of poor visibility (< 8km) due to air pollution in Hong Kong (1991-98) [2]

PUBLIC TRANSPORT

Hong Kong has an extensive and effective public transport system:

the Kowloon-Canton Railway Corporation (KCRC), operating a commuter rail line, and the Mass Transit Railway Corporation (MTRC), operating four subway lines, provide line haul commuter service

the bus companies (KMB, Citybus, New World First Bus, etc.) operating mostly double decker equipment, and the mini-bus companies provide extensive feeder/network services throughout Hong Kong Island, Kowloon peninsula and the New Territories.

taxi

ferries, providing service to outlying islands and cross-harbour

Fig. 3 shows the distribution of passengers among the various modes, while Fig. 4 shows that total passenger utilization continues to rise steadily (notwithstanding a dip in the moving average in 1998 - another effect of the turmoil in the Asian economies).

Public transport is a blessing in Hong Kong. It provides mobility for essentially the entire population, allowing Hong Kong to have one of the lowest ratios of private cars per 1000 population of any major city in Asia. Consequently, Hong Kong rarely suffers from severe traffic congestion. However, the extensive use of diesel engines in buses and taxis creates air pollution problems, which are compounded by urban delivery vans and container trucks moving produce and industrial goods between factories and the air and port terminal facilities.
Fig. 3  Number of fixed route passenger journeys by public transport operators, June 1999 [4]

![Chart showing number of fixed route passenger journeys by public transport operators in June 1999.]

Fig. 4  Trend of average daily public transport passenger journeys by month, to June 1999 [4]

![Chart showing trend of average daily public transport passenger journeys.]

Average Daily Figure  
Trend
1. LEGISLATION AND REMEDIAL PROGRAMS

Hong Kong has established five main pollution ordinances, relating to water pollution, waste disposal, air pollution, ozone layer protection, and noise control. The legal framework is thus in place, but its observance is not yet rigorously policed. Nevertheless, Hong Kong has been attempting to address problems relating to emissions from vehicles and is phasing in a series of programs:

- Unleaded gasoline, phased in since 1991. Ban on leaded gas sales since April 1999
- More than 75% of gasoline vehicles now have catalytic converters
- New vehicles must have controls on evaporative emissions, from July 1999
- Reduction of sulphur content of diesel fuel to 0.05% in 1997
- Euro II standards for diesel engines adopted since 1997
- Inspection and enforcement programs underway, for trucks, cars and motorcycles
- Restrictions on diesel-powered private cars
- All new taxis to use LPG, starting in 2001

However, in spite of these programs, air pollution and its effects continue to worsen. From 1991-97, vehicle numbers grew by 30% (from 379,500 to 492,200), and mileage driven increased by 25% (from 9.1 billion to 11.4 billion vehicle-km) [2]. Over this period:

- Particulate emissions increased 10%, from 6,450 to 7,175 tonnes per year
- NOx emissions increased 13%, from 36,130 to 40,690 tonnes per year
- VOC emissions increased 18%, from 14,050 to 16,590 tonnes per year

Therefore, action is needed to control air pollution. The Chief Executive of the SAR, Mr. Tung Chee Hwa focussed on the environment in his October 6, 1999 Policy Address, and he committed HK$30 billion expenditure over the next decade for clean-up programs. Among initiatives related to transportation are:

- Grants to encourage diesel owners to convert engines to LPG or to fit particulate traps and catalytic converters in older vehicles
- Development of a network of LPG filling stations
- Stronger action against smoky vehicles
- Euro III emission standards applied to new diesel buses and trucks from 2001
- Ban on importing new diesel taxis
- No diesel taxis allowed after 2006
- Expansion of pedestrian zones in urban and harbour-front areas
These measures will certainly help to reduce air pollution, but we need and propose more.

5. INTELLIGENT TRANSPORTATION SYSTEMS

Intelligent transportation systems (ITS) are being promoted as the solution to deteriorating traffic situations in many developed countries. The focus is on the use of advanced sensors, communications and information technology to increase safety and throughput on freeways and to ease congestion on city streets. While Hong Kong is usually an early adopter of new technology, ITS will do little to help alleviate noise and air pollution. These problems must be tackled at source - preferably by reducing the number of gasoline and diesel-powered vehicles operating in downtown areas.

Some elements of ITS are being implemented in Hong Kong, for example to improve traffic circulation by real time control of signalling at urban intersections. Other elements will be needed in the near future, including electronic road pricing - indeed such a system has already been implemented for tunnel tolls.

6. INCENTIVES AND DISINCENTIVES

The travelling habits of the public can be influenced by both incentives and disincentives. An objective must be to reduce vehicular emissions in downtown areas (primarily Causeway Bay - Central - Sheung Wan, and Tsim Sha Tsui). This can be achieved by a combination of measures:

- a substantial reduction in diesel bus penetration into downtown areas, by providing efficient transfer facilities to electric modes at the periphery
- conversion of diesel-engined vehicles to a cleaner energy source, such as LPG
- a time-sensitive electronic road pricing scheme to impose a financial penalty on taxis, private cars and delivery trucks choosing to drive into the urban areas
- the provision of new electric transportation infrastructure to provide convenient mobility

7. ELECTRIC TRANSIT

Fig. 5 illustrates a scheme to relieve air pollution in the high density downtown areas of Kowloon and Hong Kong Island. Both areas are presently well-served by spinal subway lines. The north shore of the Island also has an electric tram system, which is one of the oldest in the world and serves both as a surface transit mode and as a tourist attraction.

It is proposed:

- to build a modern two-way tram system along Nathan Road, operating between the harbour front and Jordan MTR station, with possible northerly extension to Mong Kok, on Kowloon peninsula
Fig. 5(a)  Subway and tram lines and an elevated unidirectional electric transit loop for the Kowloon peninsula
• to build two elevated (grade separated) uni-directional transit systems, first as a simple loop around the southern end of Kowloon peninsula, and second as a figure-of-eight loop along the high density Island north shore.

• to encourage private operators to run electric vehicle (EV) shuttles on fixed routes in the urban areas, as and when such vehicles become available on international markets and such services become economically viable

An elevated electric system can be quiet and pollution-free (or at least the pollution is controlled at the power station). As such, it can be designed into the urban fabric and could penetrate offices, hotels and shopping centres. The technology options for such systems include:

• vehicles with electrically driven rubber-tyred wheels, such as the Airtrans system, as implemented for the Kobe PortLiner system in Japan

• vehicles with small diameter steel wheels on steerable-axle trucks running on steel rails and driven by linear induction motors, such as the Vancouver Sky Train, also being installed in Kuala Lumpur

• vehicles with (attraction-mode) magnetic suspension and linear induction motor drive, as developed by HSST Corporation and planned for Nagoya in Japan

All these systems run on a concrete guideway, which can be designed to be integrated into an urban environment in an aesthetically pleasing manner. Each is technologically and operationally viable, and selection of the preferred mode is based on cost/performance trade-offs for a specific application.

8. CONCLUSION

Electric transit can play a major role in reducing air pollution and enhancing the quality of life in Hong Kong's dense urban environment. The implementation of appropriate incentives and disincentives and measures to persuade the travelling public to use electric transport would have an immediate impact on the attractiveness and livability/workability of downtown areas by bringing cleaner air and vitality back for residents, business persons and tourists alike.

REFERENCES


[2] Clean Air for Hong Kong; Planning, Environment and Lands Bureau, Hong Kong, 1999

[3] Air Pollution Control Ordinance, June 1996; and Air Pollution Control (Vehicle Design Standards) (Emission) Regulation 1998 (Amendment), Hong Kong Environmental Protection Department


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