

CLEAN AIR NETWORK

A Glimpse of Hong Kong's Commercial Vehicle Fleet



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Part 1: Introduction of Hong Kong Commercial Vehicle Fleet

Franchised Buses in Hong Kong

In 2009, there are 5 privately owned bus companies that provide franchised bus service across Hong Kong, operating more than 600 routes.

These are the five franchised bus companies in Hong Kong:

1. Citybus Limited
2. Kowloon Motor Bus Company (1933) Limited
3. New Lantao Bus Company Limited (Mainly provides service on Lantau Island)
4. Long Win Bus Company Limited (Mainly services Tung Chung, Disneyland Resort and routes shuttling between the Airport and New Territories)
5. New World First Bus Services Limited

Table 1: Different Franchised Bus Companies in Hong Kong

Source: "Public Transport Introduction", Transport Department ¹

| Franchise | No. of Routes | No. of Buses | Passengers/day | Franchise Length |
|-------------------|---------------|--------------|----------------|---|
| City Bus | 110 | ~ 920 | 571,000 | 2006-2016 (Fran 1) 2003-2013 (Fran. 2) |
| Kowloon Motor Bus | 380 | ~3,900 | 2,700,000 | 2007-2017 |
| New Lantao Bus | 23 | ~100 | 47,000 | 2007-2017 |
| Long Win Bus | 18 | ~160 | 79,000 | 2003-2013 |
| New World Bus | 91 | ~690 | 480,000 | 2003-2013 |

Table 2: Classification of engine types by bus company and franchise

Source: LegCo paper "Administration Response to Questions raised on 8 July 2009" ²

| Engine Type | Bus Company | | | | | | TOTAL | |
|--------------|----------------------|-----------------------|-------|-------------------|-----------------|------------------|-------|-------|
| | City Bus (Fran 1) | City Bus (Fran. 2) | KMB | New Lantao Bus | Long Win Bus | New World Bus | No. | % |
| Pre- Euro | 48 | 0 | 371 | 0 | 3 | 34 | 456 | 7.9% |
| Euro I | 312 | 4 | 938 | 2 | 0 | 82 | 1,338 | 23.2% |
| Euro II | 370 | 167 | 1,487 | 53 | 136 | 475 | 2,688 | 46.6% |
| Euro III | 10 | 0 | 1,099 | 34 | 18 | 72 | 1,233 | 21.4% |
| Euro IV | 13 | 0 | 7 | 15 | 0 | 18 | 53 | 0.9% |
| TOTAL | 750 | 171 | 3,902 | 104 | 157 | 681 | 5,768 | 100% |

¹ http://www.td.gov.hk/en/transport_in_hong_kong/public_transport/buses/index.html

² The link of LegCo Paper CB(1)2312/08-09(01):
http://www.legco.gov.hk/yr08-09/english/panels/ea/ea_iag/papers/ea_iag0708cb1-2312-1-e.pdf

Non-franchised Buses in Hong Kong

The non-franchised bus service in Hong Kong are provided by different private bus companies as a means to relieve the demand on franchised buses and green public minibuses in rush hours. They also serve some remote places which are non-profitable for franchised buses and green public minibus operators.

According to the Transport Department, there were 7,068 registered non-franchised buses in Hong Kong up to March 2009 data. Generally speaking, the services are divided into the following categories:

- Tour Service (A01)
- Hotel services (A02)
- School services (A03)
- Employee services (A04)
- International passenger Service (A05)
- Residential services / "Estate bus"³ (A06)
- Multiple Transport Service (A07)
- Contract hire services (A08)

Number of registered non-franchised public bus

Source: Transport Department "Hong Kong Public Transport" ⁴

| Non-franchised bus operators | No. of different types of non-franchised Buses | | |
|---------------------------------------|--|----------|----------|
| | Dec 1998 | Dec 2003 | Mar 2009 |
| Tour Service (A01) | 2,537 | 3336 | 2890 |
| Hotel Service (A02) | 915 | 3426 | 2562 |
| Student Service (A03) | 2,988 | 4265 | 4045 |
| Employees' Service (A04) | 2,259 | 2432 | 1908 |
| International passenger Service (A05) | 570 | 745 | 983 |
| Residents' Service (A06) | 841 | 1055 | 1097 |
| Multiple Transport Service (A07) | N.A. | N.A. | N.A. |
| Contract Hire Service (A08) | 3,000 | 6720 | 5751 |
| Total* | 5868 | 7206 | 7068 |

³ Residential Service non-franchised buses: providing feeder services between new towns and urban areas; sometimes also operating between the management company of private housing estates and bus companies, as a mean to carry residents from where they live to major transport interchanges.

⁴ The link of "the number of registered non-franchised public bus"
[http://www.td.gov.hk/filemanager/en/content_297/reg%20public%20nfb%20\(mar09\)eng.pdf.pdf](http://www.td.gov.hk/filemanager/en/content_297/reg%20public%20nfb%20(mar09)eng.pdf.pdf)



Remarks:

*The total number of the registered non-franchised buses is not equal to the sum of the different types of non-franchised bus operators because a non-franchised bus usually provides more than one kind of services.

**Please see appendix A for the chart of “the number of registered non-franchised public buses” from Transport Department in 1998-2009.

Public light buses

They provide feeder services to buses and the railway. According to the law, there can only be 4350 minibuses. They can be divided into two types: red public minibuses and green public minibuses.

Part 2: The Franchise System

The Franchise Agreements

The Public Bus Service Ordinance (PBSO) provides for the granting of franchises by the Chief Executive in Council to operate public bus services on specified routes, and the regulation of the operation. The key elements of the franchises are:⁵

- The open bidding process for selecting and approving franchises;
- Guarantees by operators that they will maintain certain prices, routes, and a percentage of their fleet in service;
- An annual Forward Planning Programme agreed between the Commissioner and
- the operators, which monitors the acquisition of new buses and other capital expenditure;²
- Provisions outlining the rates of guaranteed returns to the operators;²
- Emergency powers for the Chief Executive to suspend or alter the fleet;
- Nationalization and expropriation terms upon which the government takes
- possession of bus assets and revokes franchises; and
- Other administrative and maintenance features.

Franchises are granted for an initial period of 10 years, with the possibility to extend by a further 5 and then a further 2 years, or 17 years in total, subject to review.

Five Year Forward Planning Programme

The bus operators work on a five year rolling Forward Planning Programme which covers the operators' operations and maintenance, and includes routes and schedules, fleet maintenance, retirement of older vehicles and proposed capital expenditure (acquisition of new buses). There is no public participation in this process.

As part of this annual assessment, the Transport Department also monitors the bus operators' fleet for compliance with an Agreement entered into in 1997, between the Transport Department and the bus operators. In this Agreement the bus operators have committed to retire buses from their fleets before the anniversary of the 18th year from first registration, or specifically, once they reach 17 years and 364 days in operation (the 18 year rule). Non-compliance with this Agreement is subject to financial penalties imposed by the Transport Department.⁶

⁵ Heimark, E., Ialogianni, H., Kilburn, M., and Loh, C. (2009). "Payign for a Cleaner Bus Fleet: How government can break the long jam". Civic Exchange

⁶ Ibid.

Profit Control Scheme

The current franchises contain a guaranteed rate of return mechanism which governs the financial return to the operators, known as the Profit Control Scheme. The operators' return is a function of the (net) fixed assets utilised by the franchisee in any given year. Since 1997, the HKSAR Government has set the maximum permitted returns to the operators as 9.7% per annum. The Profit Control Scheme is reviewed every two years by the Transport Department and the Chief Executive in Council.

By making use of the franchised agreement, the government can indeed require franchise operators to adhere to environmental performance standards for the purpose of reducing exhaust emissions.

Part 3: Details of Commercial Vehicles Fleet: the number, the total kilometers traveled and contribution to roadside emissions

Table 3: Total Number of Registered Vehicles, the total kilometers travelled (2005)

Source: Legco Question 10: Information on certain classes of vehicles⁷

| Vehicle class | Current number of vehicles (no gross limit) | Number of vehicles of permitted gross vehicles | | Vehicle kilometers travelled (million) – year 2005 | Vehicle kilometers travelled (million) – year 2006 |
|---------------------------------------|---|--|------------|--|--|
| | | 15<x<24 tonnes | >24 tonnes | | |
| Franchised bus fleet of bus companies | 5,887 | 5,282 | 0 | 513 | 513 |
| Non-franchised buses | 7,568 | 1,686 | 0 | 333 | 359 |
| Medium goods vehicles | 42,718 | 31,461 | 0 | 1,333 | 1,347 |
| Heavy goods vehicles | 3,429 | 0 | 3,429 | | |
| Trailers | 20,507 | 90 | 20,376 | | |
| Special Purpose Vehicles | 1,178 | 194 | 76 | | |

Table 4: The contribution of total roadside emission of different vehicle classes (2005)

Source: Legco Question 10: Information on certain classes of vehicles

| Vehicle classes | The emission model of different vehicle classes' contribution to roadside emissions | | | |
|------------------------|---|------------------------------------|--------------------------------|----------------------|
| | Respirable Suspended Particulates (RSP) | Nitrogen Oxides (NO _x) | Volatile Organic Carbons (VOC) | Carbon Monoxide (CO) |
| Franchise Bus | 5 % | 10 % | <5 % | <5 % |
| Non-franchise Bus | 5 % | 5 % | <5 % | <5 % |
| Heavy goods vehicles * | 55 % | 55 % | 15 % | 5 % |
| Others ** | N.A. | N.A. | N.A. | N.A. |

Remarks:

⁷ <http://www.info.gov.hk/gia/general/200705/30/P200705300123.htm>

* Heavy vehicles: including medium goods vehicles, trailers on tow by good vehicles and special purpose vehicles

** Others: including light buses, petrol private cars, taxis and motor cycles

Table 5: The contribution of total roadside emissions of different vehicle classes (2007)⁸

Source: Answer from EPD (17 Dec 2009)

| Vehicle Classes | The emission model of different vehicle classes' contribution to roadside emissions | | | |
|------------------------|---|--------------------------|--|-------------------------|
| | ** Respirable Suspended Particulates (RSP) | ** Nitrogen Oxides (NOx) | ** Volatile Organic Carbons (VOC) ⁹ | ** Carbon Monoxide (CO) |
| Franchise Bus | 5 % | 10 % | 30 % | 15 % |
| Non-franchise Bus | 5 % | 5 % | | |
| Heavy goods vehicles * | 50 % | 55 % | | |
| Light goods vehicles | 25 % | 15 % | | |
| Light buses | 10 % | 15 % | 25 % | 45 % |
| Petrol Private Cars | | | 30 % | 25 % |
| Taxi | | | 15 % | 15 % |
| Motor Cycles | | | | |

Remarks:

* Heavy vehicles: including medium goods vehicles, trailers on tow by good vehicles and special purpose vehicles

** May not sum to 100% due to rounding

⁸ This is a combined chart of two different charts. Please see appendix B for the original charts provided by EPD.

⁹ Regarding VOC and Co, petrol and LPG vehicles are the dominant contributors and their percentages of vehicle emissions based on 2007 data

Part 4: RSP and NOx emissions of Commercial Diesel Vehicles

Figure 1: Annual emissions of RSP from all Vehicles in 2006

Source: Legco paper "Item for Finance Committee" (9 Feb 2007) ¹⁰

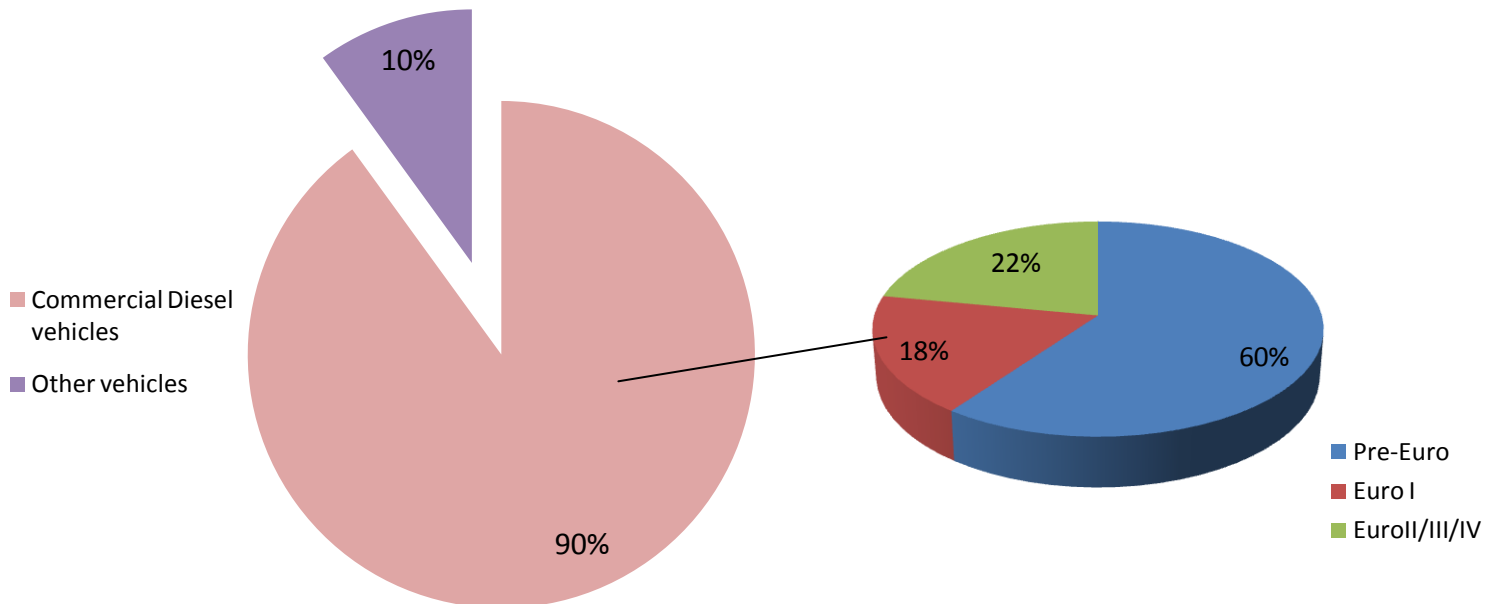
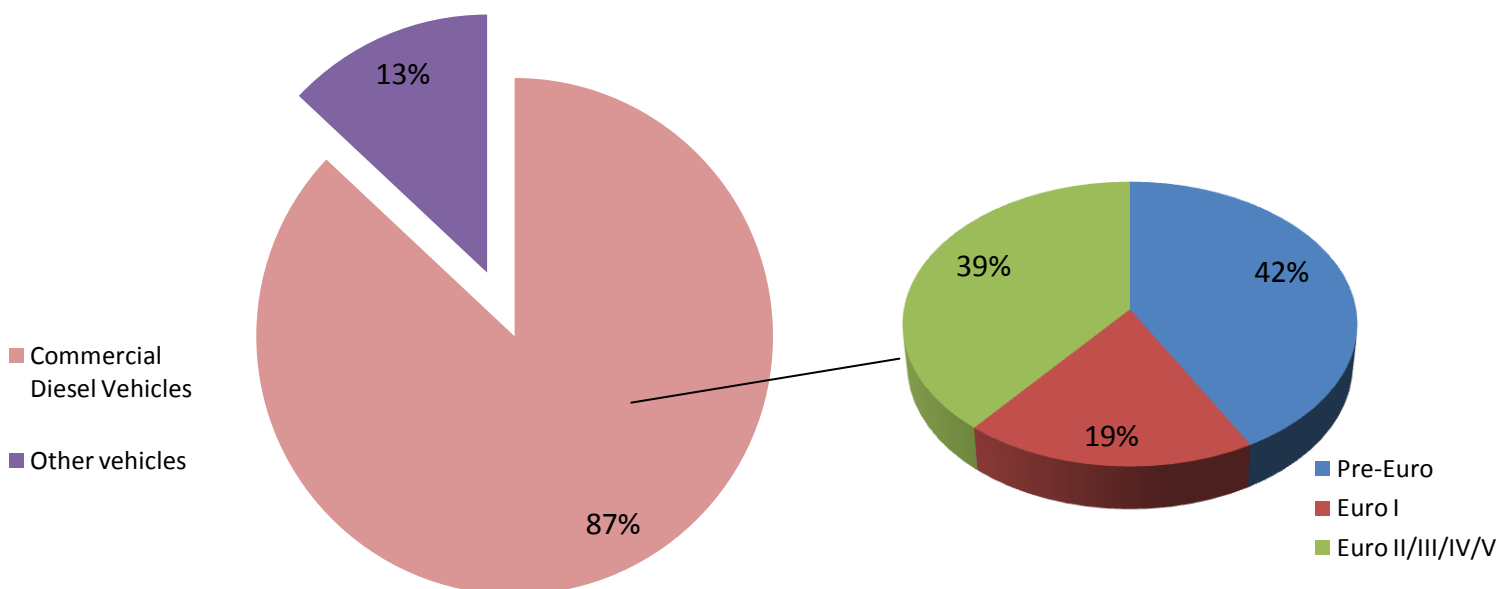


Figure 2: Annual emissions of RSP from all Vehicles in 2008

Source: Legco's administrative Paper on "Early Replacement of Old Vehicles" (24 Nov 2008) ¹¹



¹⁰ The link FCR (2006-07)41: <http://www.legco.gov.hk/yr06-07/english/fc/fc/papers/f06-41e.pdf>

¹¹ The link (CB (1) 223/08-09 (08):

<http://www.legco.gov.hk/yr08-09/english/panels/ea/papers/ea1124cb1-223-8-e.pdf>

Figure 3: Annual emissions of NOx from all vehicles in 2006

Source: *Source: Legco paper "Item for Finance Committee" (9 Feb 2007)* ¹²

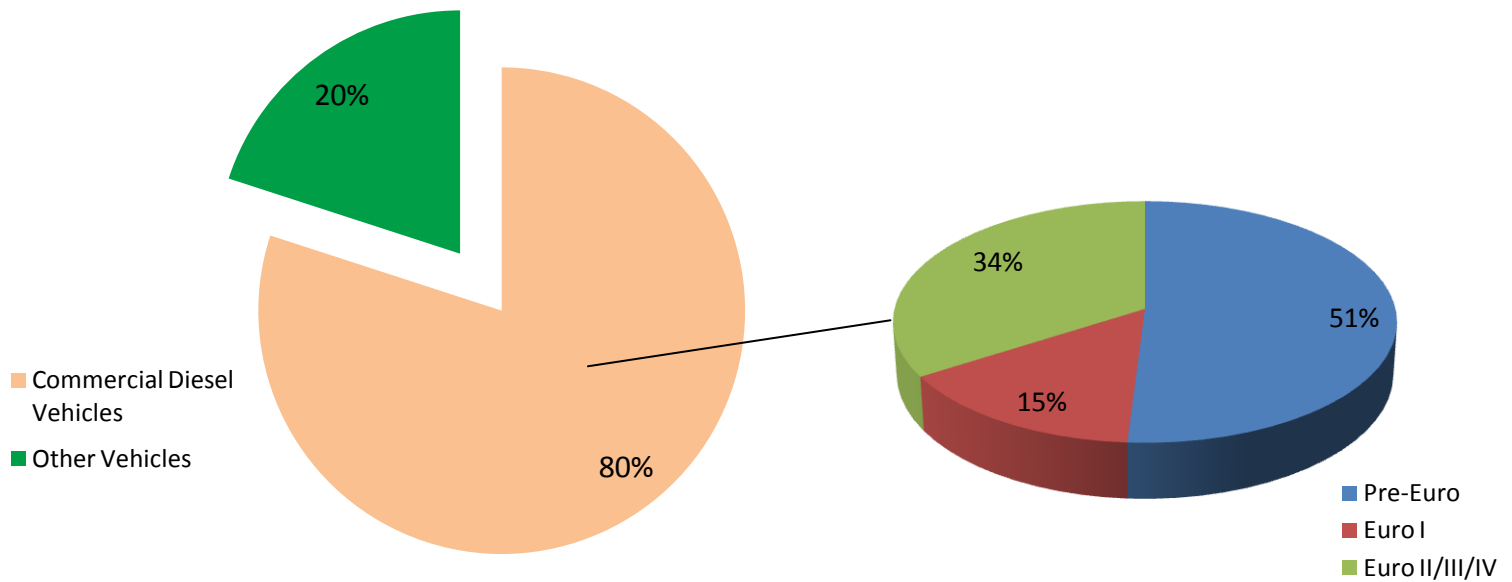
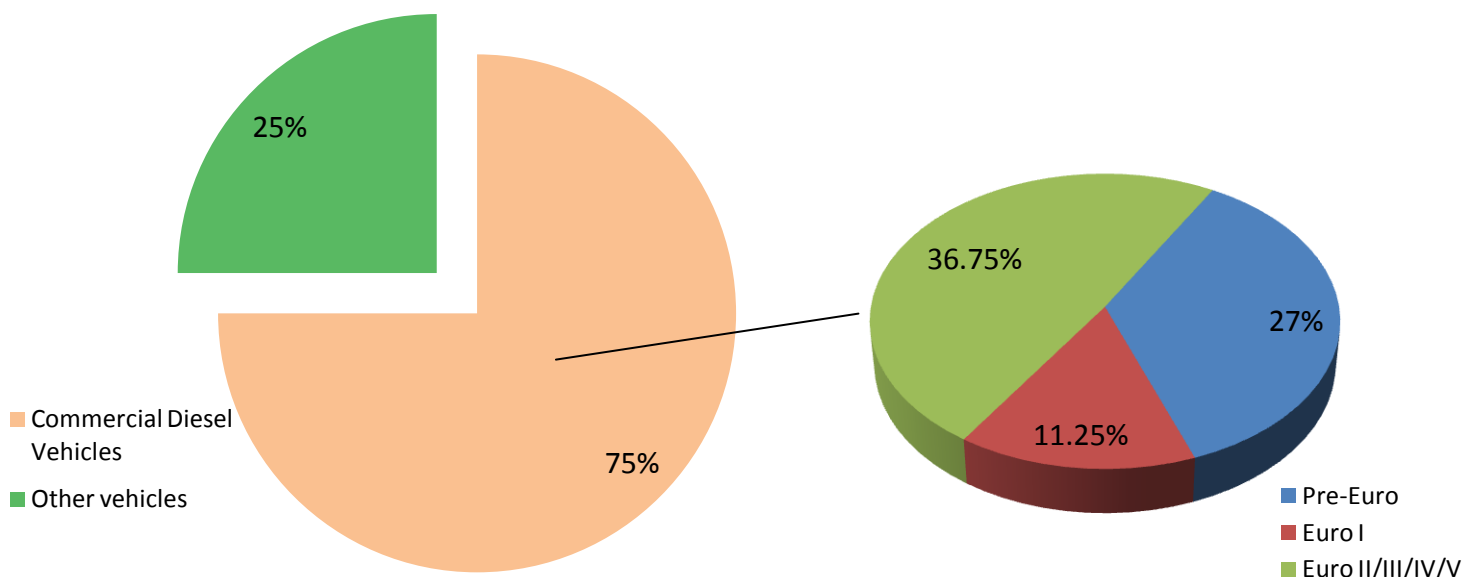


Figure 4: Annual emissions of NOx from all vehicles in 2008

Source: *Legco's administrative Paper on "Early Replacement of Old Vehicles" (24 Nov 2008)* ¹³



¹² The link FCR (2006-07)41: <http://www.legco.gov.hk/yr06-07/english/fc/fc/papers/f06-41e.pdf>

¹³ The link (CB (1) 223/08-09 (08):

<http://www.legco.gov.hk/yr08-09/english/panels/ea/papers/ea1124cb1-223-8-e.pdf>

Table 6 : Comparison of Emission amount among Pre-Euro, Euro I and Euro IV engines

Source: LegoCo paper “Encouraging owners of pre-Euro and Euro I diesel commercial vehicles to replace their vehicles by offering one-off grant” (20 Dec 2006)¹⁴

| | RSP | NOx |
|----------|------|-------|
| Pre-Euro | 30 x | 2 x |
| Euro I | 15 x | 1.5 x |
| Euro IV | 1 x | 1x |

Table 7: Estimated emission reduction if pre-Euro and Euro I diesel commercial vehicles replaced by Euro IV model

Source: LegoCo paper “Encouraging owners of pre-Euro and Euro I diesel commercial vehicles to replace their vehicles by offering one-off grant” (20 Dec 2006)¹⁵

| | All pre-Euro and Euro I vehicles replaced by Euro IV models |
|-----------------------------------|---|
| Vehicular emissions from RSP | -74% |
| Vehicular emissions from NOx | -38% |
| Territory-wide emissions from RSP | -18% |
| Territory-wide emissions from NOx | -10% |

¹⁴ The link (CB(1)513/06-07(03):

<http://www.legco.gov.hk/yr06-07/english/panels/ea/papers/ea1220cb1-513-3-e.pdf>

¹⁵ Ibid.

Part 5: Some Fast Facts from the Bus paper¹⁶

- In Hong Kong, there are 11 million passenger trips per day in the public transport public system
- Franchised buses account for over 1/3 of the public transport passenger flow in Hong Kong
- Commercial diesel fleet accounts for 70% of distance traveled – dominant roadside polluter
- Singapore: 20% engines belong to Euro IV and above together with adopting engine Euro V and compressed natural gas buses
- HK: less than 1% or only 53 buses belong to Euro IV or above engine
- Euro IV commercial diesel vehicle emits about 80% and 30% less RSP and NOx respectively than a Euro III
- The certificate of roadworthiness: an annual test to check general car safety and the level of emissions (a test of density not toxicity). It sets a cap on emissions (maximum permitted smoke or vapour level) at 50 H.S.U. for new vehicle s and 60 H.S.U. for older vehicles.

¹⁶ Heimark, E., Ialogianni, H., Kilburn, M., and Loh, C. (2009). "Payign for a Cleaner Bus Fleet: How government can break the long jam". Civic Exchange.
<http://www.civic-exchange.org/eng/upload/files/091127Bus.pdf>

Part 6: CRT technology - An Alternative Currently adopted by Bus Companies in Reducing Emissions

Bus companies try to treat air pollution by using catalytic convertors – commonly known as diesel oxidation catalysts (DOCs) which remove CO, NOx and unburnt hydrocarbons by converting these gases into gas and water but cannot reduce the problem of RSP, especially PM2.5. Currently, DOCs are only able to remove 20-30% of particulates from bus vehicle emissions.¹⁷

However, with the regeneration trap (CRT) technology having been developed, it acts as a filter to take out particulates. CRT can either be an integral part of the vehicle exhaust system or retrofitted onto the exhaust pipe of the vehicle with CO₂ is the resultant product. It is technically suitable for most vehicle models in Hong Kong. In general, black smoke and odour (characteristic signs of particulate emissions) are removed with drastic reductions of exhaust particulate emissions by up to 90%. The average cost of a CRT is HK\$50,000 per unit and the maintenance cost is about HK\$3,000 per year.¹⁸

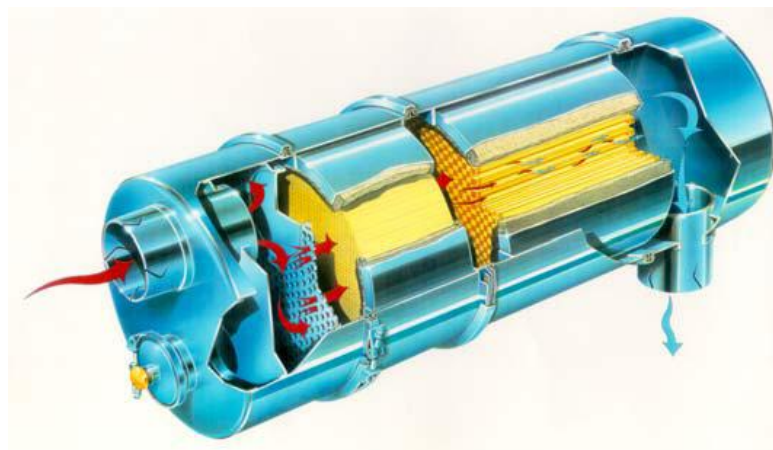


Figure 5: CRT Equipment

Currently there are roughly 960 CRTs fitted onto franchised buses belonging to Kowloon Motor Bus (560 units), Citybus (21 units), New World First Bus (225 units) and New Lantau Bus (61 units). Approximately one-third of CRTs have been retrofitted and the remainder line-fitted.¹⁹

¹⁷ Yuen, Raymond. "Reducing Exhaust Particulates from Buses". Business Environment Council. [http://www.bec.org.hk/FrontEnd/upload/File/Air%20Pollution/1%20-%20Reducing%20Exhaust%20Particulates%20from%20Buses\(1\).pdf](http://www.bec.org.hk/FrontEnd/upload/File/Air%20Pollution/1%20-%20Reducing%20Exhaust%20Particulates%20from%20Buses(1).pdf)

¹⁸ *ibid.*

¹⁹ *Ibid.*

Based on lab tests, actual results are given in the table below. _

Table 8: Effect of CRT on Euro II engines²⁰

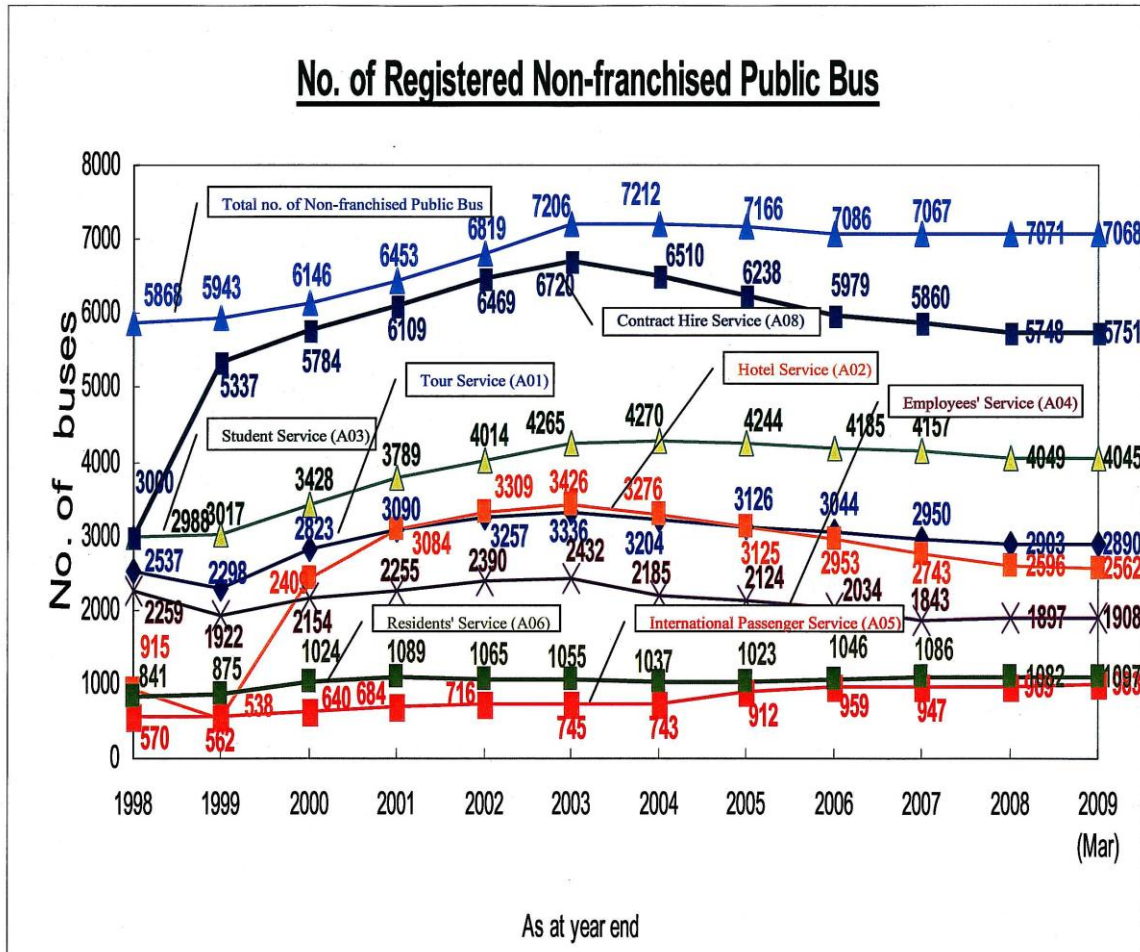
| | Euro II | Euro II plus CRT | Environmental Saving (kg/year) |
|-----|---------|------------------|--------------------------------|
| RSP | 15 | 1 | 14 |
| HC | 61 | 4 | 57 |
| CO | 87 | 8 | 79 |
| NOX | 543 | 471 | 72 |

All figures are in kg per year, based on an annual mileage of 100,000 km.

²⁰ Millbrook Report: MBK980431 on Euro II Scania P94 310 Bhp distribution vehicle.

Appendix A

Number of registered non-franchised public bus (2009)



Appendix B

Percentages of vehicle emissions for RSP and NOx (2007)

| | RSP | CO |
|----------------------|------|------|
| Heavy Goods vehicles | 50 % | 55 % |
| Light Goods Vehicles | 25 % | 15 % |
| Non-Franchise Buses | 5 % | 5 % |
| Franchised Bus | 5 % | 10 % |
| Others | 10 % | 15 % |

Percentages of vehicle emissions for VOC and CO (2007)

| | VOC | CO |
|---|------|------|
| Petrol private Cars | 25 % | 45 % |
| Taxi | 30 % | 25 % |
| Motor Cycles | 15 % | 15 % |
| Others (inc. goods vehicles, light buses and buses) | 30 % | 15 % |

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