Overview of Vehicle Emission Remote Sensing Programme in Hong Kong

Dr MAK Shing-tat
Principal Environmental Protection Officer
Environmental Protection Department
Hong Kong SAR, China
26 July 2018

環境保護署
Environmental Protection Department

Major Air Pollution Challenges

- Roadside air pollution
- Regional smog [PM2.5 (visibility), ozone]

Roadside air pollution

Concentrations of nitrogen dioxide (NO_2) at roadside double the Air Quality Objective (AQO) limit (40 μg/m^3)

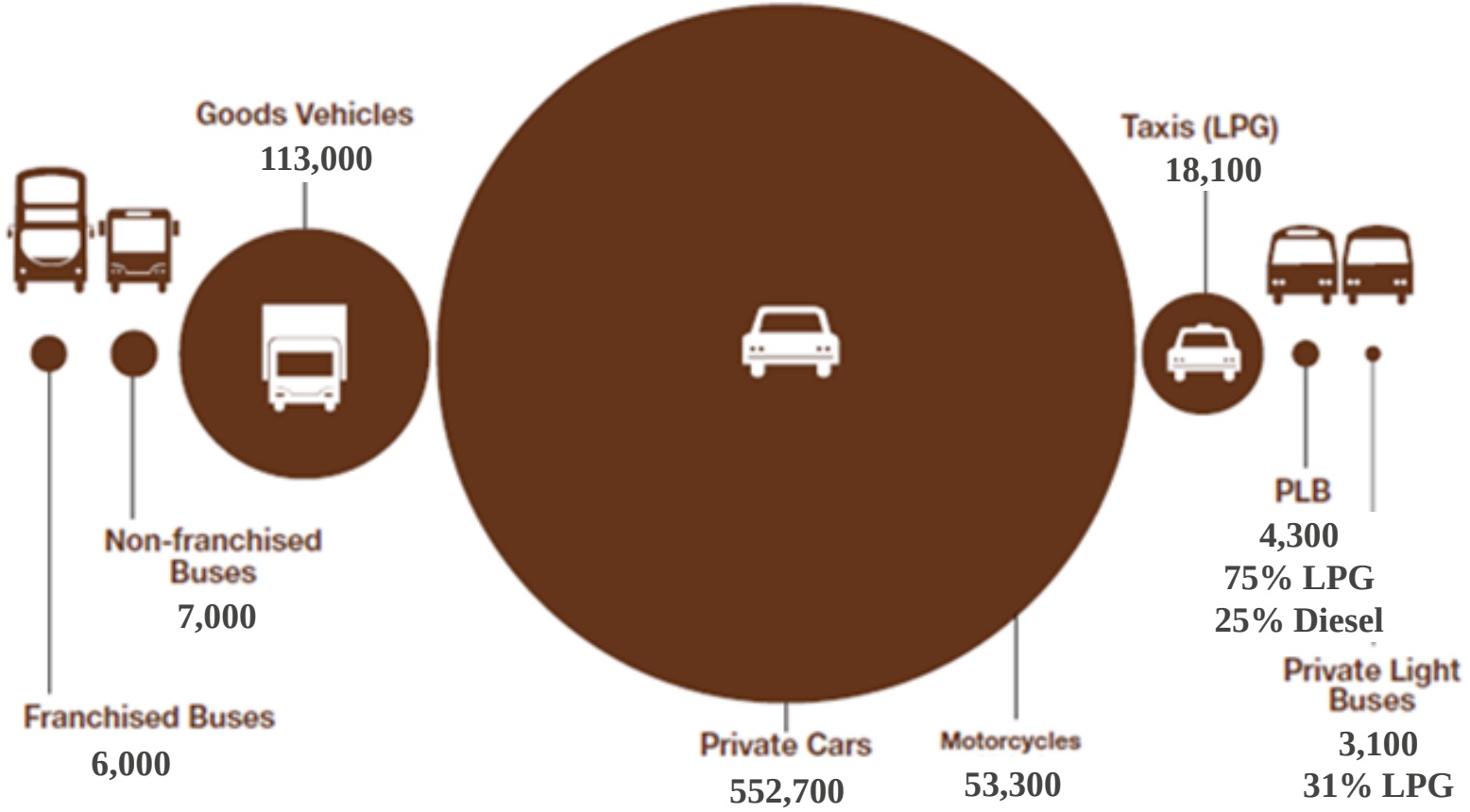
- High vehicle intensity especially commercial vehicles
- Poor dispersion at street canyon

Commercial vehicles represent 20% of vehicle fleet

but 93% of NOx and PM emission from the fleet

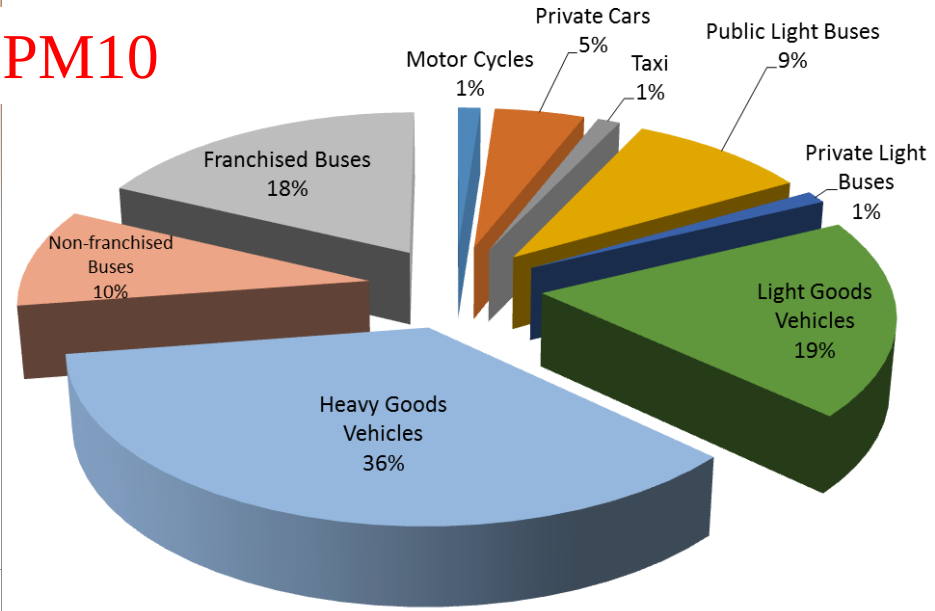
Vehicle Population in Hong Kong

Types and numbers of licensed vehicles in Hong Kong (as at end 2017)

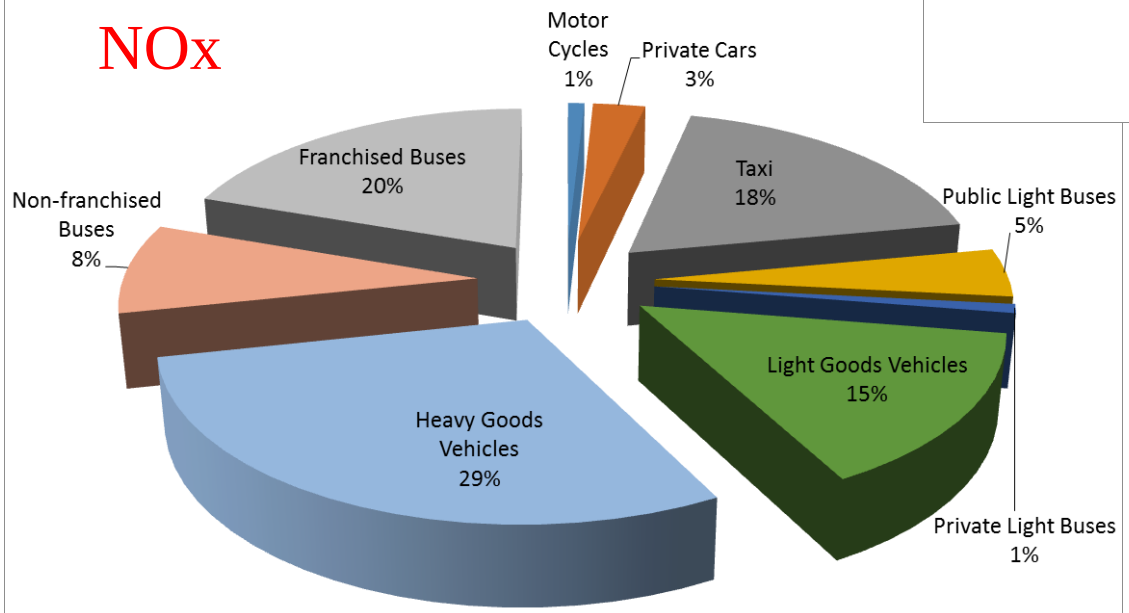


2016 Vehicle Emissions

PM10



NOx

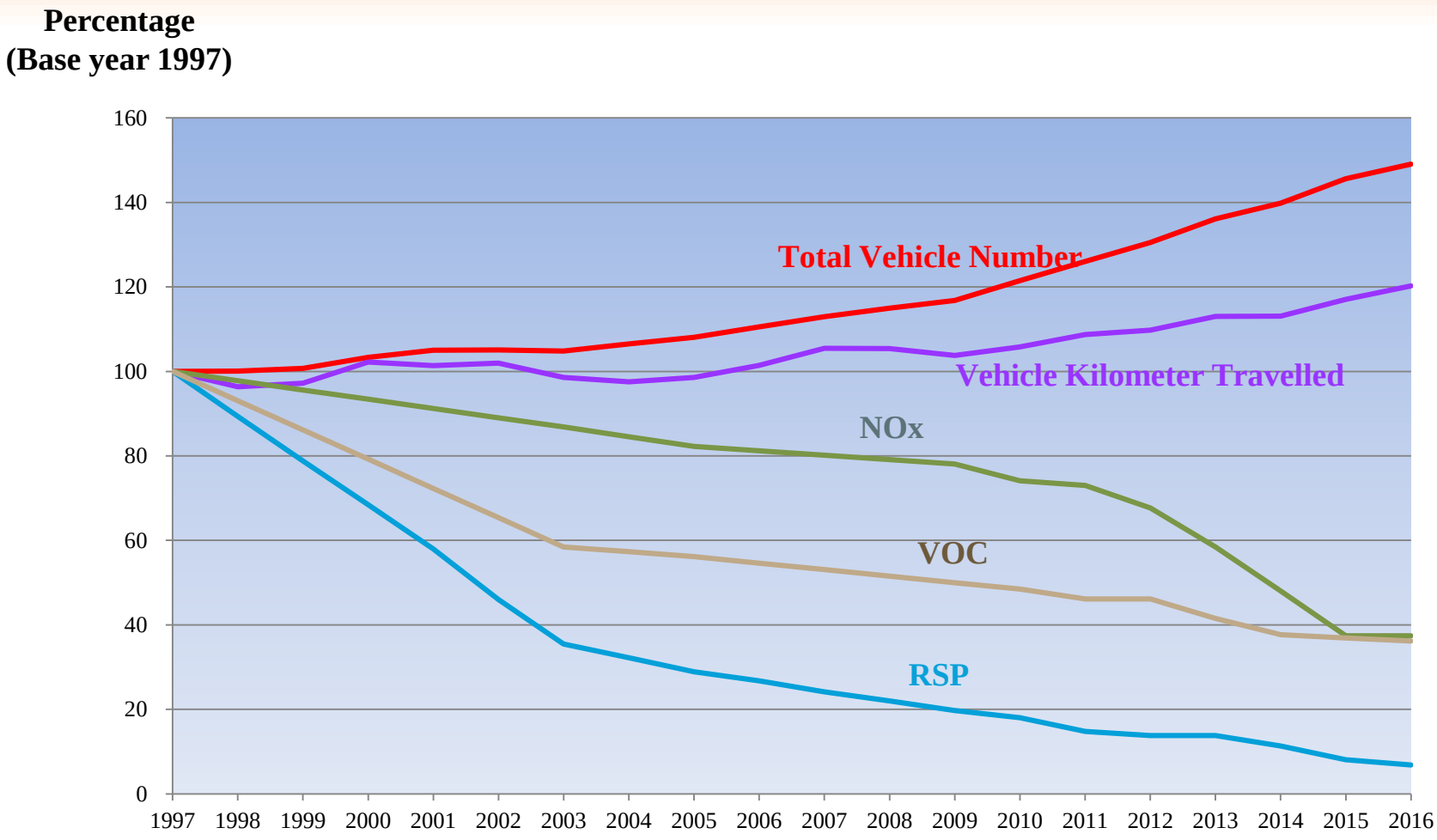


Commercial vehicles account for over 93% PM and NOx emissions from vehicle fleet

Vehicle Emission controls

- Impose most stringent vehicle emission and fuel standards where practicable
- Phase out old diesel commercial vehicles
- Retrofit vehicles with emission reduction device
- Step up vehicle emission inspection and control
- Promote the use of electric vehicles and cleaner alternatives

Vehicle Number vs Vehicular Emissions

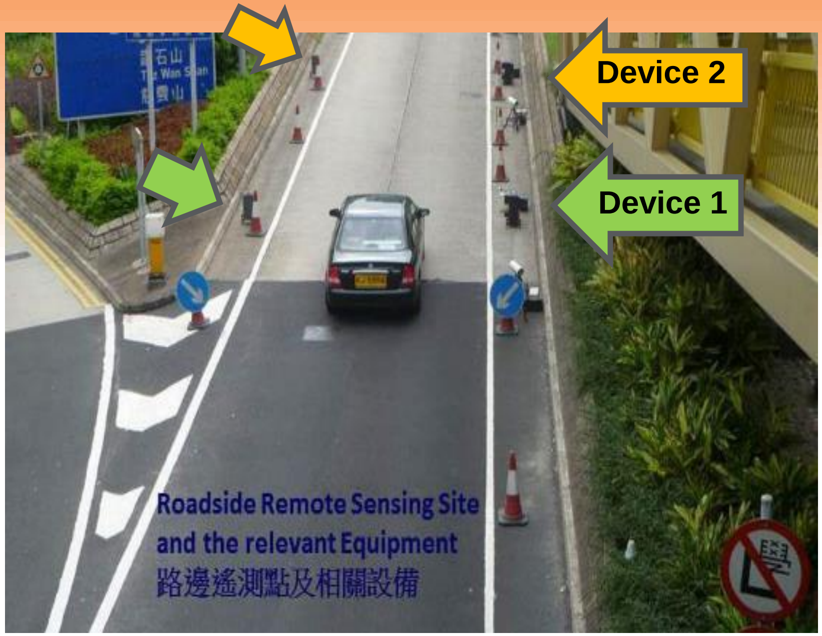


Hong Kong EPD
Remote Sensing Programme

- Small scale survey since 1993
- Dirty screen enforcement since Sept 2014
- About 100 remote sensing selected sites in different areas of territory
- Deploy up to 3 roadside remote sensing teams per day (all sensing operations by contractors)
- Deployment determined by EPD considering vehicle and geographical coverages
- 100% data QC and vehicle follow up by EPD

Site selection and data QC are important. To be explained in another presentation.

- Portable roadside remote sensing equipment to screen out gross emitters in the petrol and LPG vehicle fleet
- Dual device setup by about 1 second apart (fail by both devices ONLY)
- EPD will issue an Emission Testing Notice (ETN) to the owner of a vehicle emitting excessively



Environmental Protection Department
Mobile Source Group
34/F, Revenue Tower
5 Gloucester Road
Wan Chai, Hong Kong
環境保護署

TEL NO.: 3619 6610
FAX NO.: 2877 4337

XXX

XXX
XXX

第374章道路交通條例
ROAD TRAFFIC ORDINANCE CAP. 374

EMISSION TESTING NOTICE TO REQUIRE A VEHICLE
TO BE TESTED AT A VEHICLE EMISSION TESTING CENTRE

Vehicle Registration Mark: AA111 PRIVATE CAR
Reference Number: EP/G 1/100900107/2017
VIN number: JT 11UE 000324

PLEASE TAKE NOTE that in connection with a report made against the above-mentioned vehicle as follows:
Date: 30 September 2017
Location: Connaught Rd. West (near Sheung Wan Fire Station)
Time: 2:51PM
Cause of report: EXCESSIVE EMISSION

You as the registered owner of the above-mentioned vehicle, are required in accordance with section 77B of the Road Traffic Ordinance, Cap. 374 to produce the vehicle, together with this notice and a copy of the Vehicle Registration Document, for testing in a manner as stated below:
Date: Not later than 13 November 2017
Vehicle emission testing centre: One of the centres given in the attached list for the purpose of ascertaining whether the vehicle complies with vehicle emission standards.

Vehicle Testing Standards			
Transient Emission Test on Chassis Dynamometer			
(1) Hydrocarbons (HC) not over	g/km	(3) Nitrogen Oxides (NOx) not over	g/km
(2) Carbon Monoxide (CO) not over see overleaf	g/km	(4) HC + NOx not over see overleaf	g/km

The fee for each emission test is: $ 620

I must point out that I may refuse to license or cancel the licence of a motor vehicle if on testing the vehicle is found not to comply with prescribed vehicle emission standards. In this respect you are required to obtain a certificate of compliance from the vehicle emission testing centre not later than 13 November 2017

Please also note that in accordance with section 25(1)(b) of the Ordinance, I may refuse to license or cancel the licence of a motor vehicle if the registered owner of the vehicle fails to have the vehicle tested at a vehicle emission testing centre when required to do so by me.

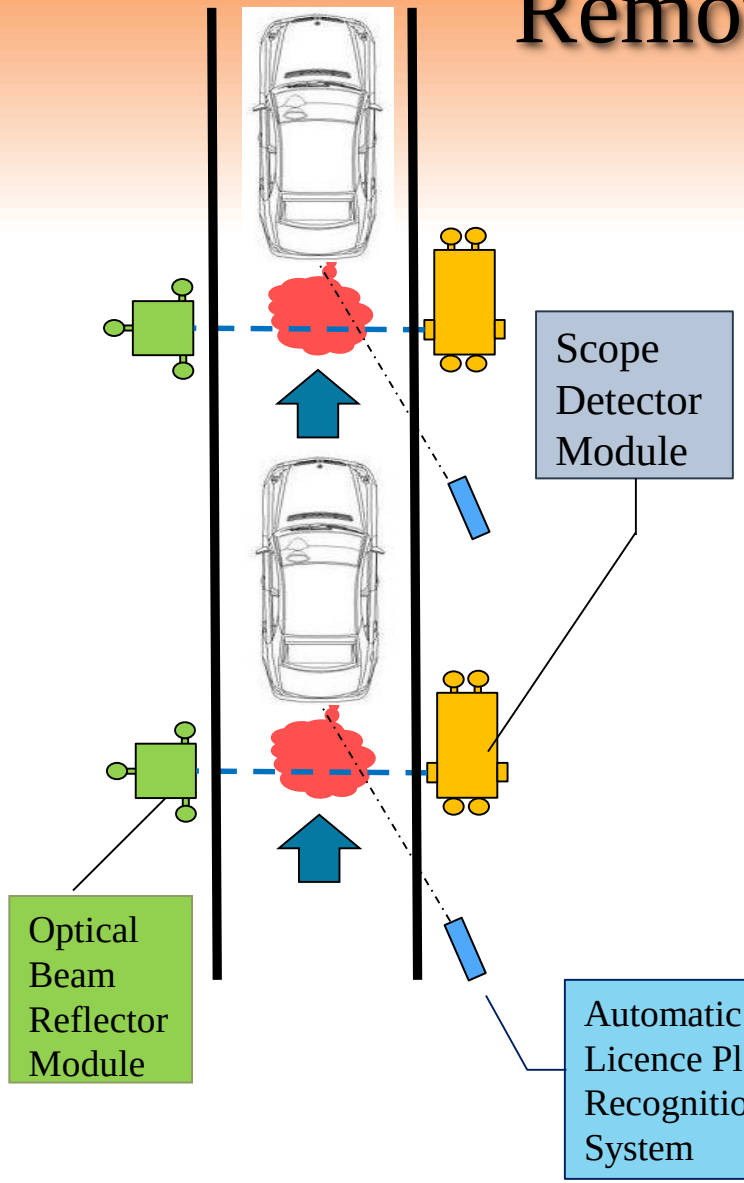
Date: 26 October 2017

(SO Sze-hong)
for Commissioner for Transport

EPD 121P

- Vehicle owner has to fix the excessive emission problem
- Vehicle has to pass an emission test done with the aid of a chassis dynamometer at designated vehicle emission testing centre within 12 working days from receipt of an ETN
- Failure to pass the test may lead to cancellation of the vehicle licence by the Transport Department
- May appeal ETN with sound maintenance history

Remote Sensing Equipment



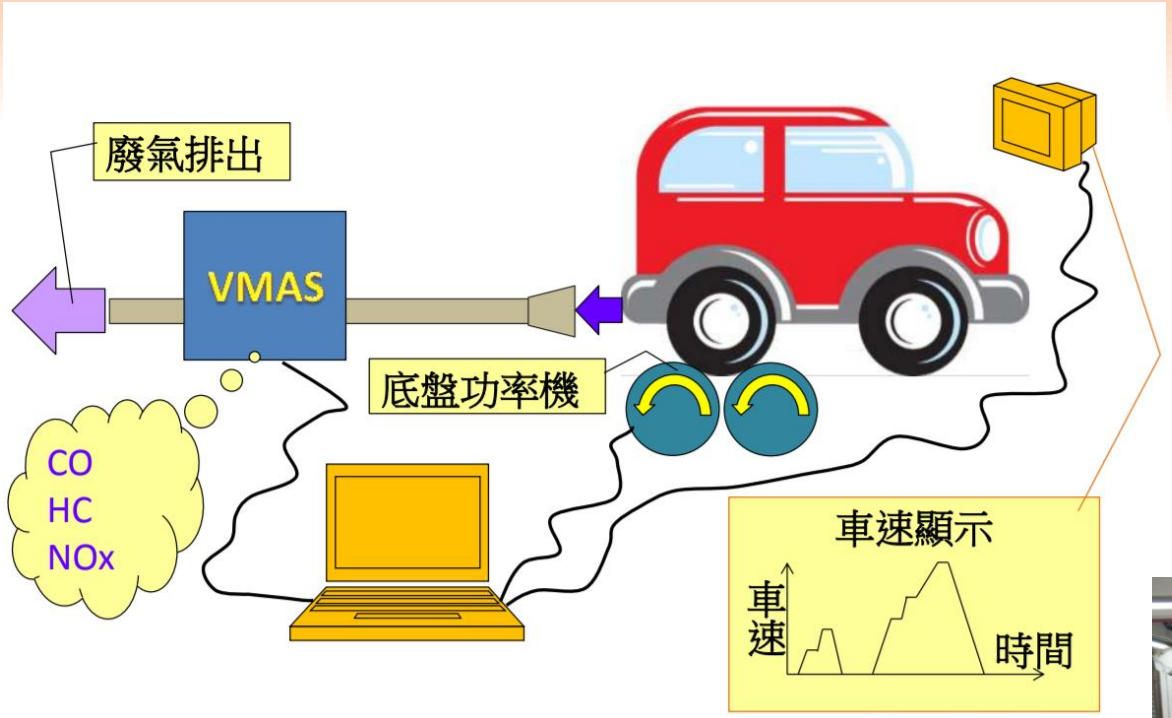
Optical Beam Reflector Module

Automatic Licence Plate Recognition System

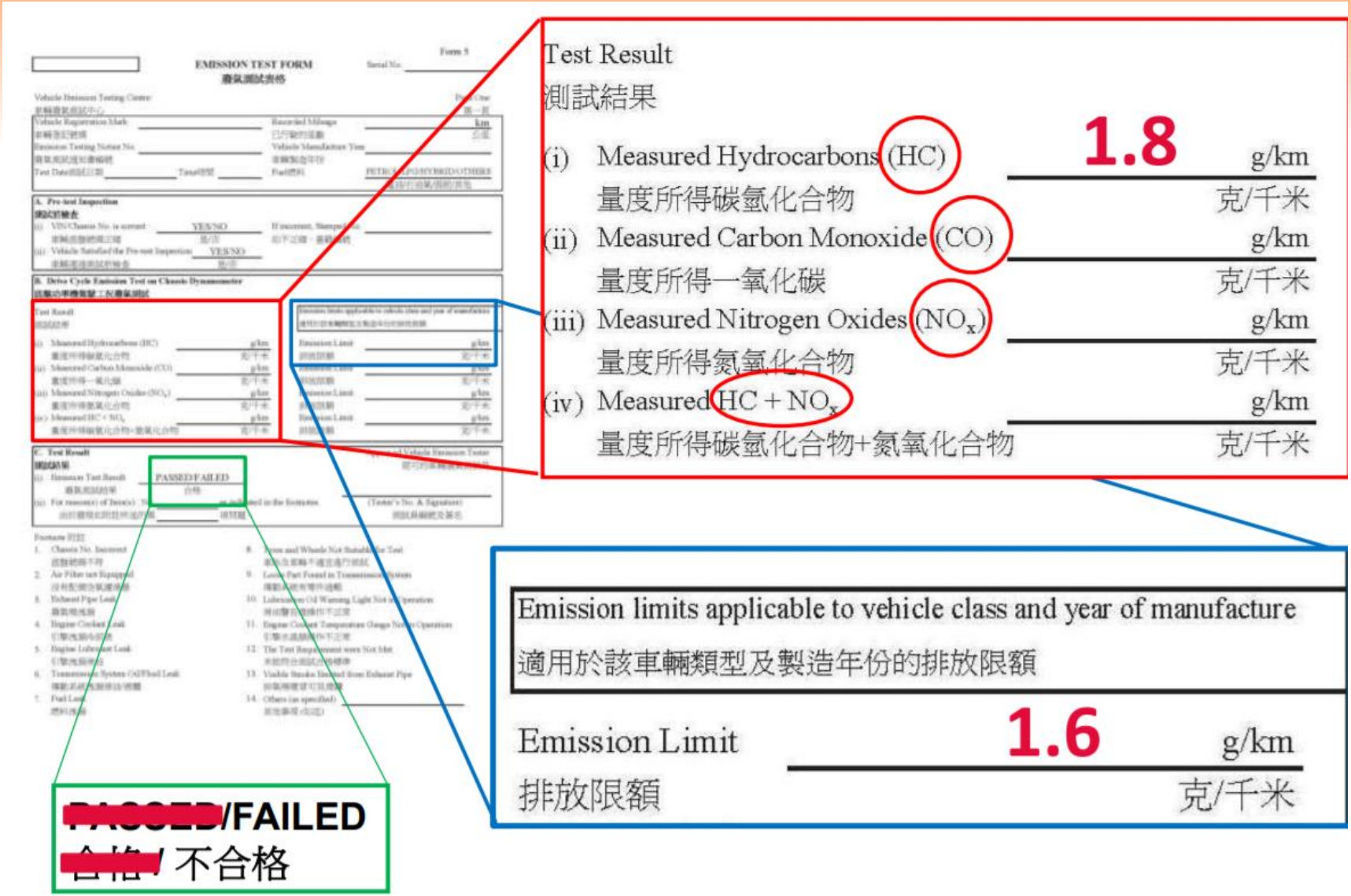
Scope Detector Module

Central Control Console Module

Designated Vehicle Emission Testing Centre



Emission Test Report

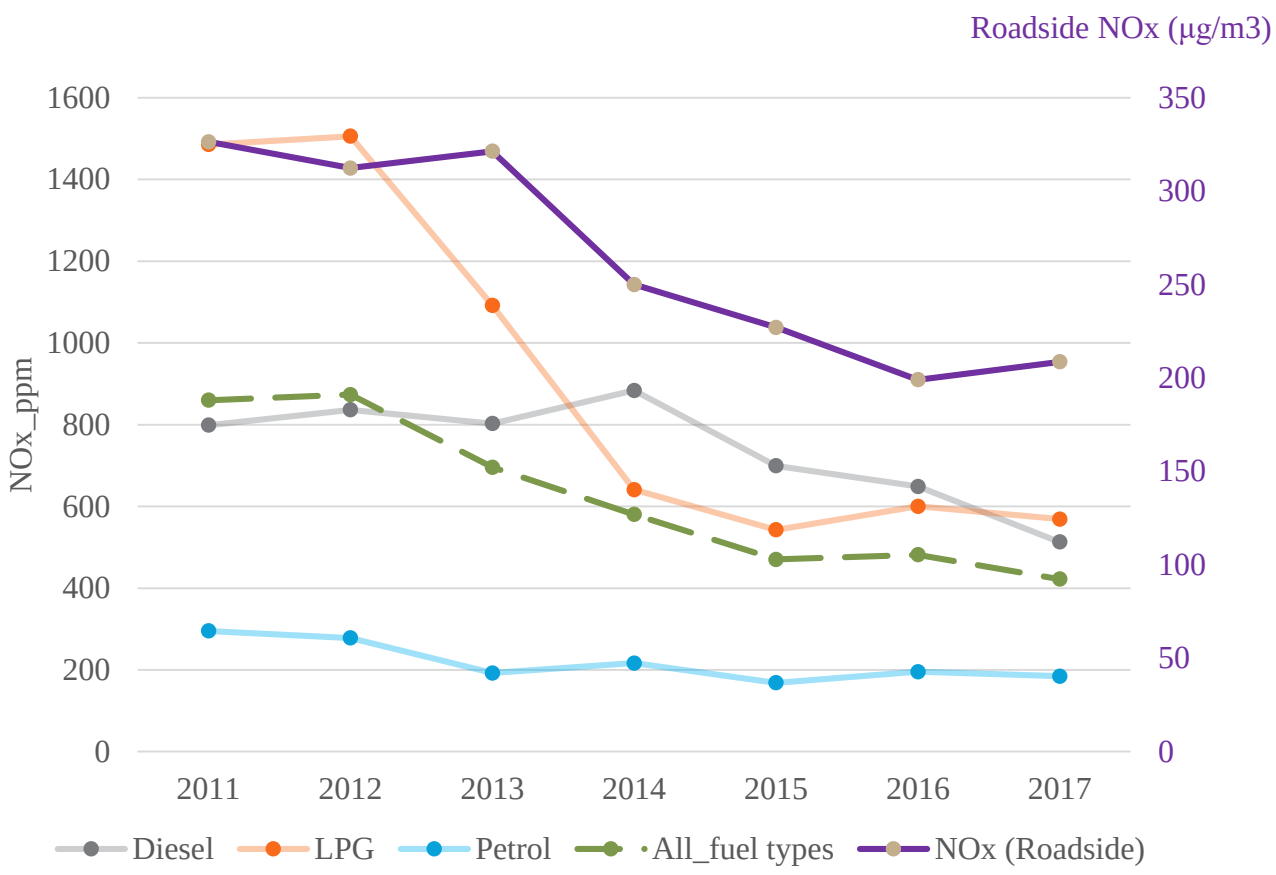


Test failed if failing any limit of CO, HC or NOx

Hong Kong EPD
Remote Sensing Programme

- As at June 2018,
  - About 2.4 million vehicle-counts monitored
  - About 13,000 emission testing notices issued
  - Most vehicles passed dynamometer emission test after repair
  - About 500 vehicle licences cancelled for non-compliance

Tailpipe NOx detected by Remote Sensing by Fuel Types



Both tailpipe and roadside NOx concentrations show a downward trend.

From 2012 to 2017,

LPG vehicles - 63% ↓

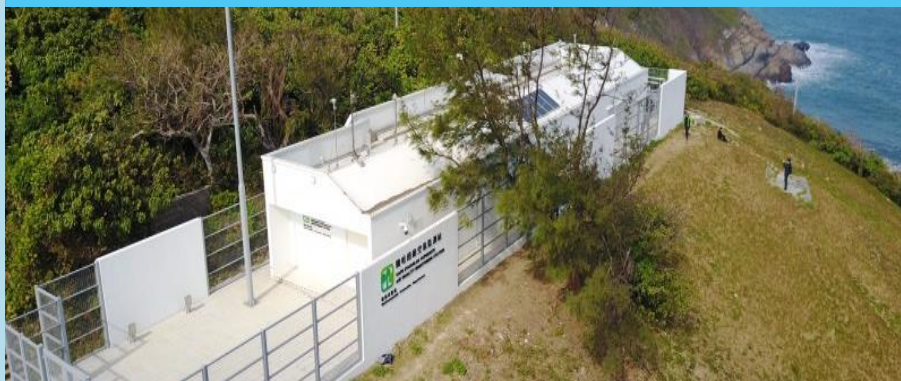
Overall fleet - 52%↓

Roadside - 33%↓

Air Quality Monitoring Network

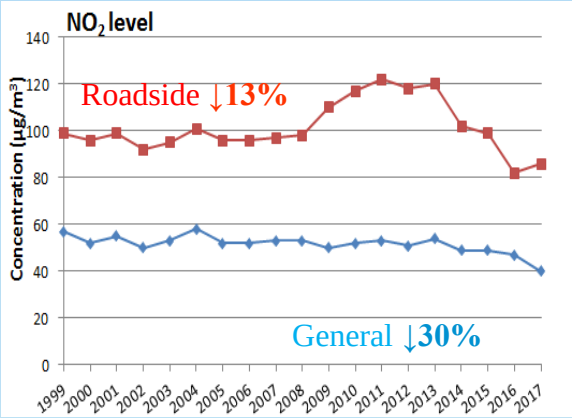
AQMS

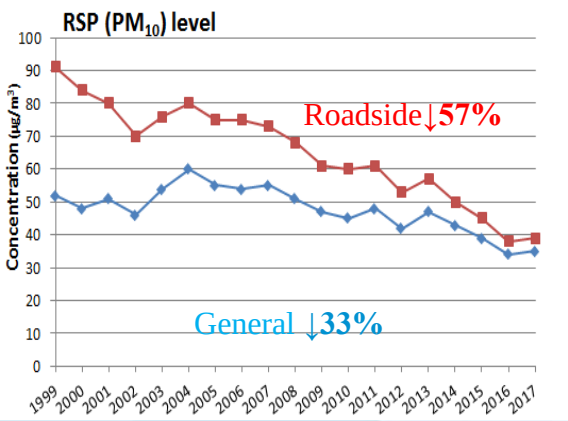
Supersite

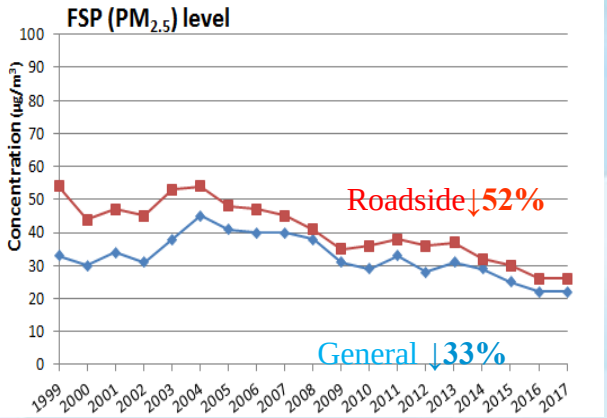


Air Quality is Improving Gradually

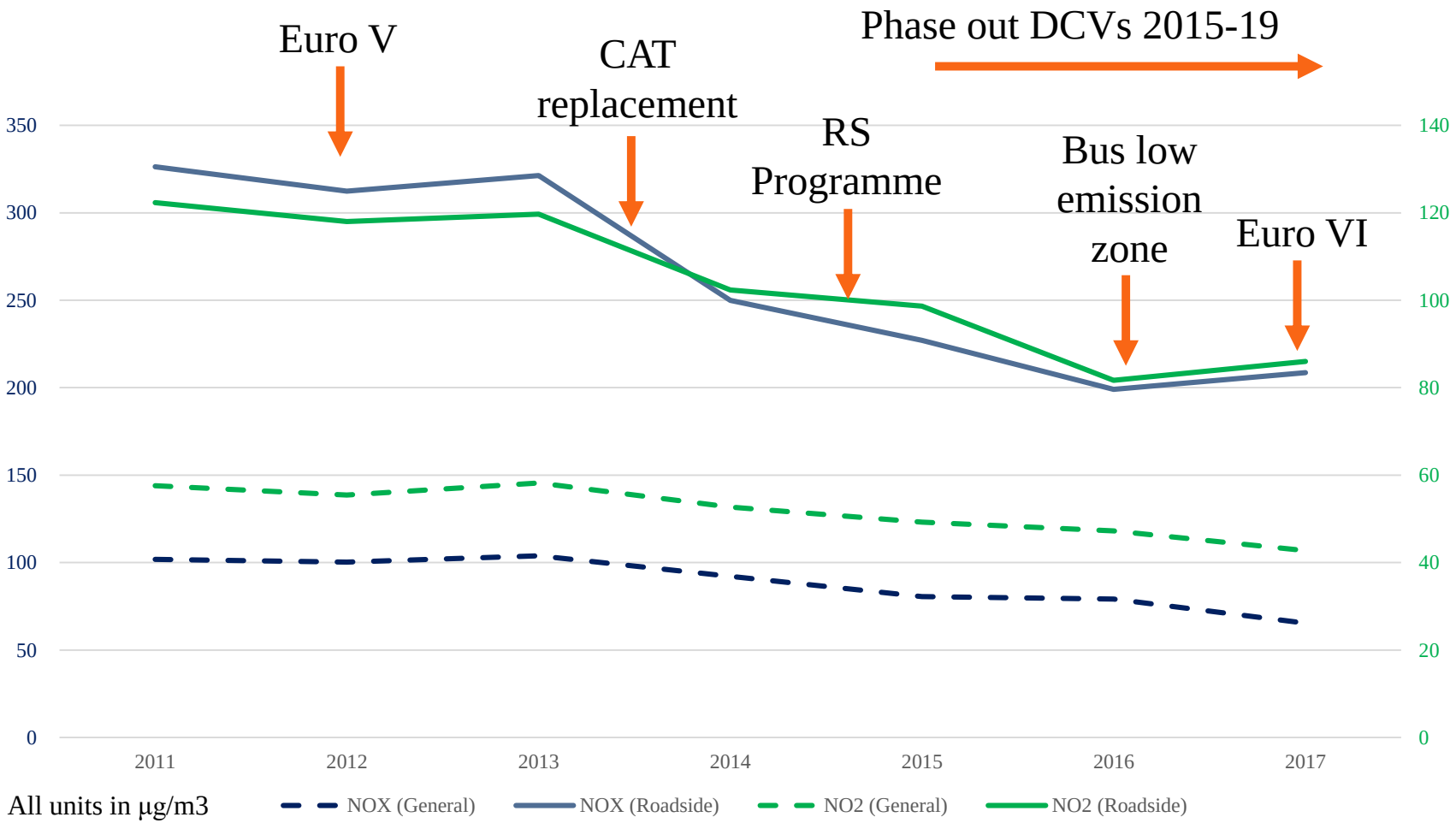
- Air Quality (1999 – 2017)







NO2 & NOx Level (2011-2017)



Advantages of Vehicle Emission Remote Sensing

- Non-intruding / voluntary / easier to deploy
- Relatively low cost
- Drill down to individual vehicle
- Possible for multiple measurements compare with other methods (e.g. Average 8 monitoring per taxi in first half of 2018)
- Large data set for mining of information and programme evaluation (about 0.6 million monitoring per year under current operation)
- Real world emission data

Considerations on Further Use of Remote Sensing

- Need multiple measurements on subject vehicles/groups for trend analysis and programme evaluation, therefore, sufficiently large data set is required to carry out analysis
- Strategic deployments for coverage to identify problematic vehicles/groups

Remote Sensing Equipment Future Development

- More precise remote sensor to tie in with tightened vehicle emission standards (for Euro 4 / Euro 5 or above petrol / diesel vehicles, currently the most stringent RS standard is Euro 3)
- Diesel emission is low concentration high volume in nature - need more precise remote sensor for dirty screen (cut point in NOx could be down to 100ppm/10% CO2 for Euro V trucks)
- Exhaust plume turbulence affects remote sensing measurement (equipment design and site setup essential) (to be covered in another presentation)
- Need to consider remote sensor certification method to fully take into account of turbulence in remote sensing sample

Our Plan

- Step up the roadside remote sensing from currently 3 teams to 5 per day in 2018
- Tighten the dirty screen cut point for Euro 4 or above petrol/LPG vehicles when more precise remote sensor is available
- Extend the dirty screen to diesel vehicles

Thank you !

Remote Sensing Cut Points (Private Cars)

Manufacturing Year		Emission Standard	NOx (ppm)	CO (%)	HC (ppm)
From	To				
1975	1995	Pre Euro	4000	5	500
1996	1997	Euro 1	2000	2	500
1998	2000	Euro 2	1500	2	500
2001	2005	Euro 3	750	2	500
2006	2012	Euro 4	750	2	500
2013	2016	Euro 5	750	2	500
2017		Euro 6	750	2	500

Air Quality (2011-2017)

	General				Roadside			
YEAR	NO2	NOX	NO2/NOX	O3	NO2	NOX	NO2/NOX	O3
2011	58	102	59%	38	122	326	38%	13
2012	55	100	57%	37	118	312	38%	15
2013	58	104	58%	39	120	321	37%	14
2014	53	92	60%	43	102	250	41%	21
2015	49	81	63%	42	99	227	44%	19
2016	47	79	61%	39	82	199	42%	19
2017	43	65	66%	49	86	209	43%	23

	General				Roadside			
YEAR	CO	FSP	RSP	SO2	CO	FSP	RSP	SO2
2011	63	32	48	14	95	38	61	12
2012	78	28	42	11	101	36	53	10
2013	78	31	47	13	92	37	57	11
2014	65	29	43	11	85	32	50	9
2015	68	25	39	10	75	30	45	8
2016	75	22	34	9	85	26	38	7
2017	68	22	35	8	75	26	39	7

All Pollutant unit in µg/m3 except CO which is in 10µg/m3

> Annual NO2 limit of 40 ug/m^3