Overview of Vehicle Emission Remote Sensing Programme in Hong Kong

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Major Air Pollution Challenges

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

Roadside air pollution

Concentrations of nitrogen dioxide (NO₂) at roadside double the Air Quality Objective (AQO) limit (40 μ g/m³)

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

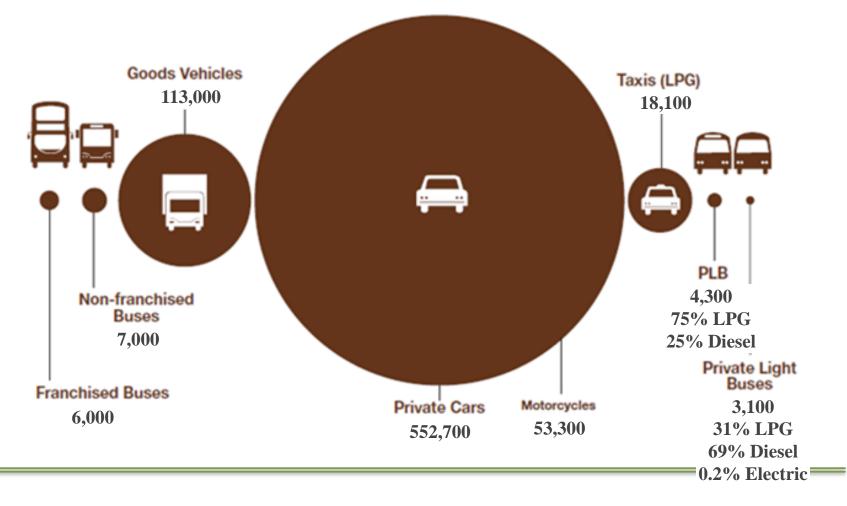
Commercial vehicles represent 20% of vehicle fleet

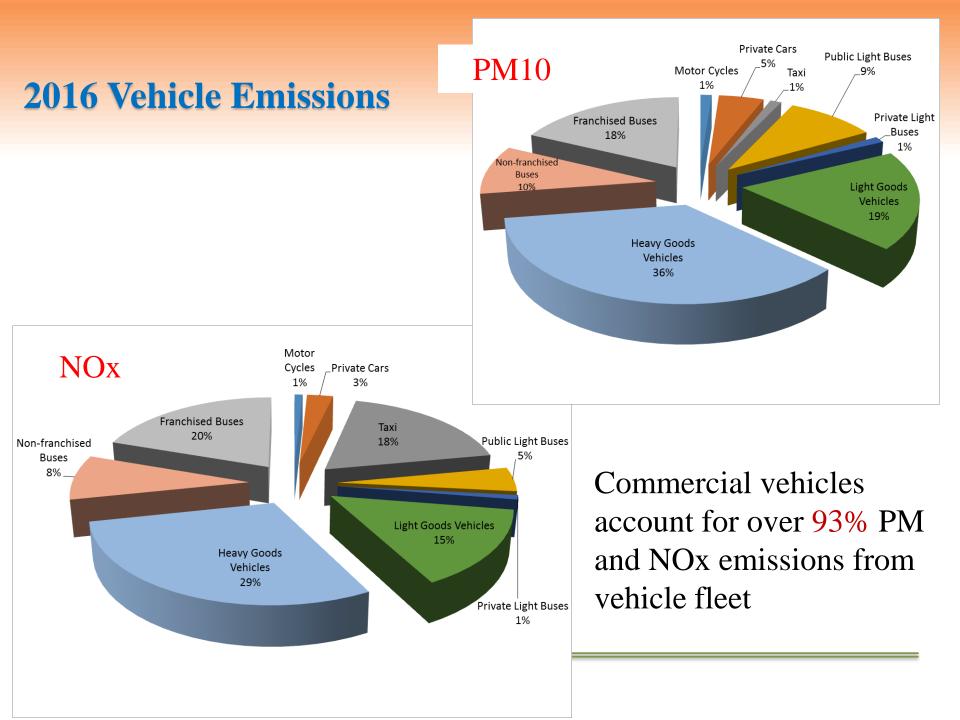
but 93% of NOx and PM emission from the fleet



Vehicle Population in Hong Kong

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







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









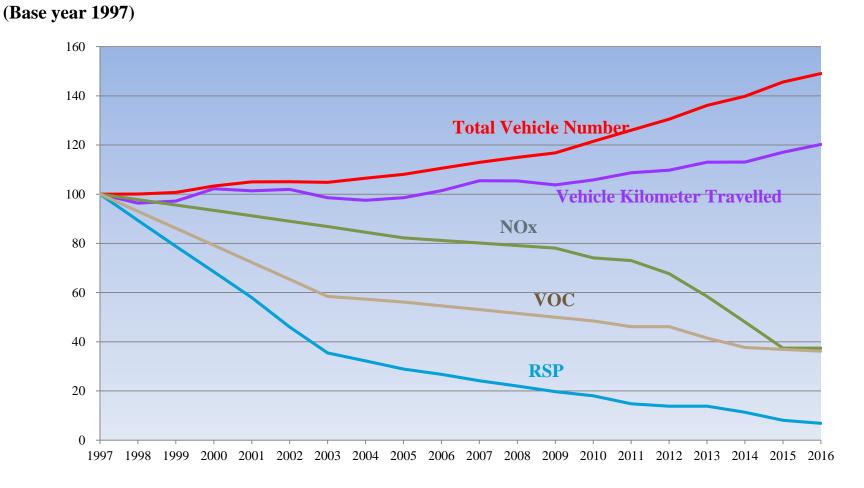
DCV retirement deadlines





Vehicle Number vs Vehicular Emissions

Percentage

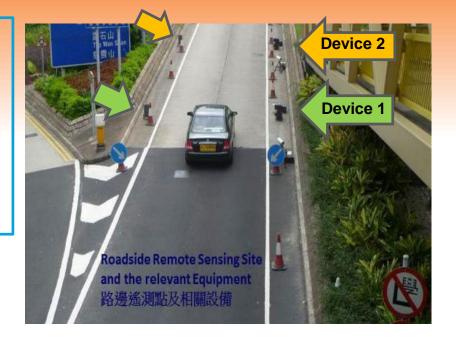


Hong Kong EPD Remote Sensing Programme

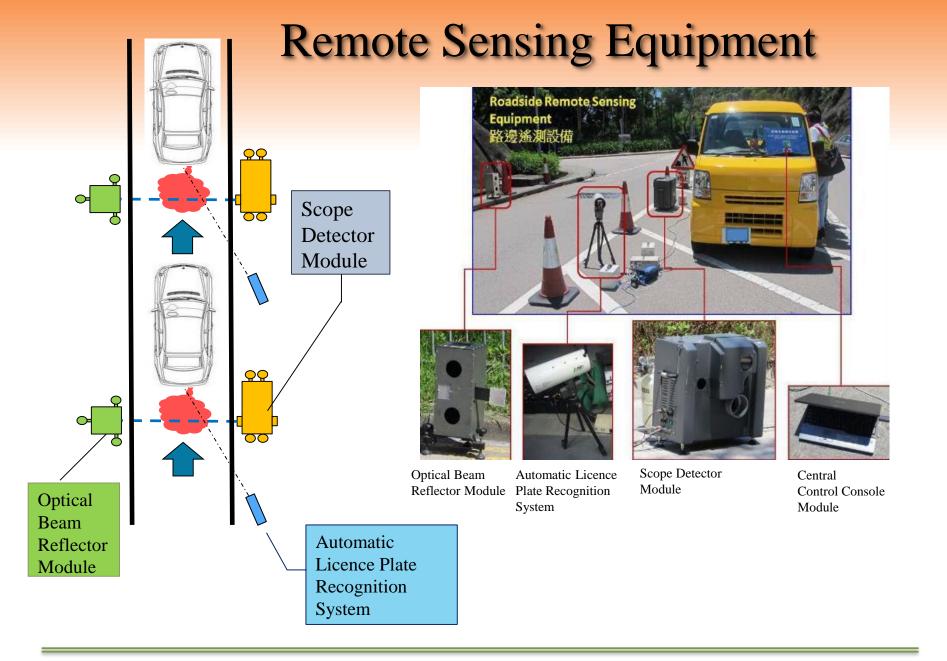
- Small scale survey since 1993
- Dirty screen enforcement since Sept 2014
- About 100 remote sensing selected sites in different areas of territory
- Deploy up to 3 roadside remote sensing teams per day (all sensing operations by contractors)
- Deployment determined by EPD considering vehicle and geographical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

- 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

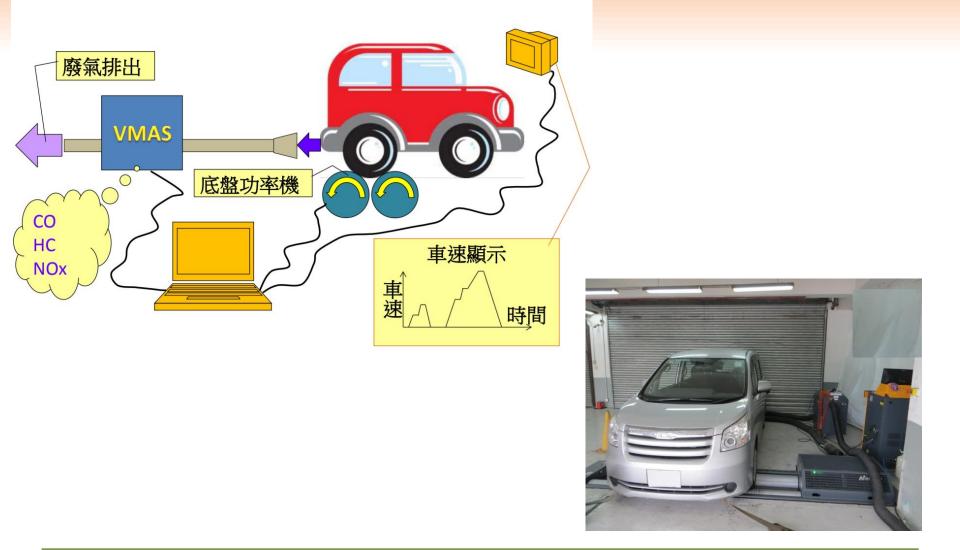
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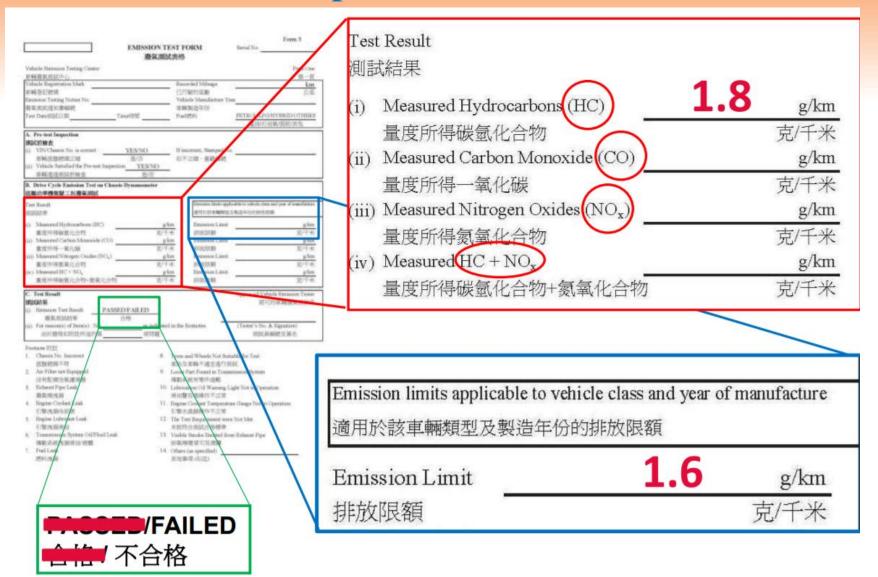
- Vehicle owner has to fix the excessive emission problem
 Vehicle has to pass an emission test done with the aid of a chassis dynamometer at designated vehicle emission testing centre within 12 working days from receipt of an ETN
 Failure to pass the test may lead to cancellation of the
 - vehicle licence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



Designated Vehicle Emission Testing Centre



Emission Test Report

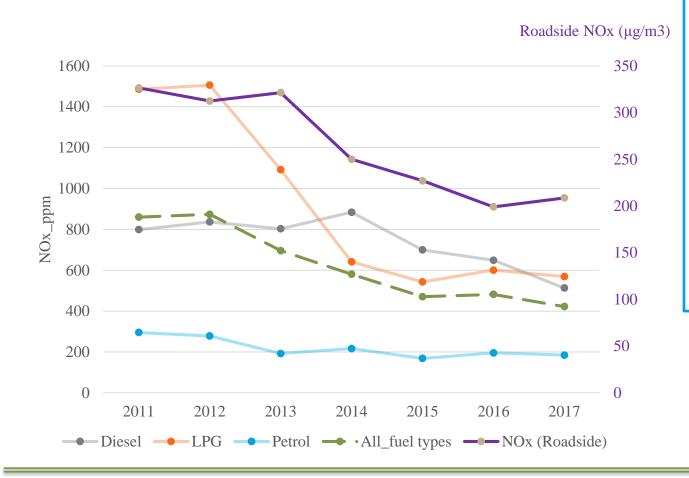


Test failed if failing any limit of CO, HC or NOx

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 noncompliance

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 - $63\% \downarrow$ Overall fleet - $52\%\downarrow$ Roadside - $33\%\downarrow$

Air Quality Monitoring Network



AQMS

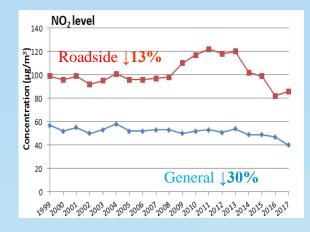


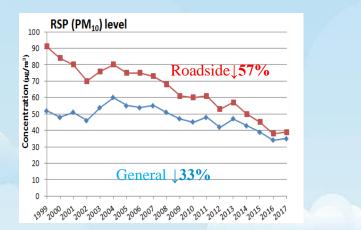
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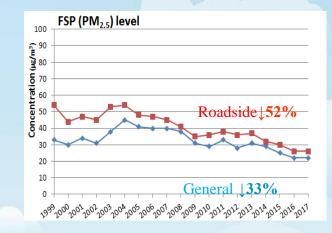


Air Quality is Improving Gradually

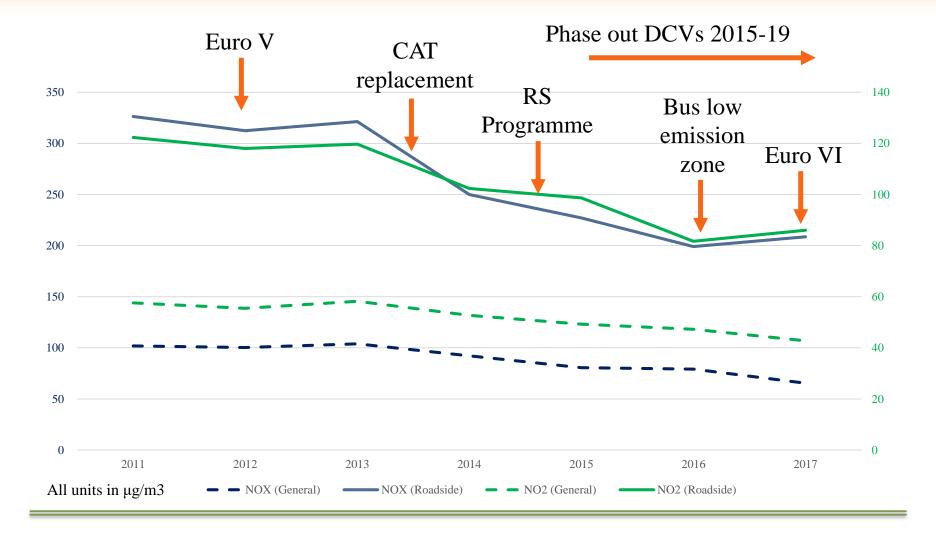
• Air Quality (1999 – 2017)







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)

Manufac	anufacturing Year Emission		NOv (nnm)	CO(0/2)	HC(nnm)	
From	То	Standard	NOx (ppm)		nc (ppiii)	
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	03	NO2	NOX	NO2/NOX	03
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	<u>43</u>	65	66%	49	<u>86</u>	209	43%	23

	General				Roadside			
YEAR	СО	FSP	RSP	SO2	СО	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 $\mu g/m3$ except CO which is in $10\mu g/m3$

> Annual NO2 limit of 40 ug/m³