

# EMFAC-HK

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# Vehicle Emission Inventory

- The methodology used to estimate vehicle emission inventories in Hong Kong
- Discuss only the traffic data
- Making use of traffic data from TD, HyD and EPD's surveys

The background of the slide is a blue-tinted photograph of a vast, calm ocean extending to a clear horizon. The sky is filled with soft, wispy white clouds. The overall color palette is a range of blues, from deep navy to light sky blue.

# Vehicle Activities

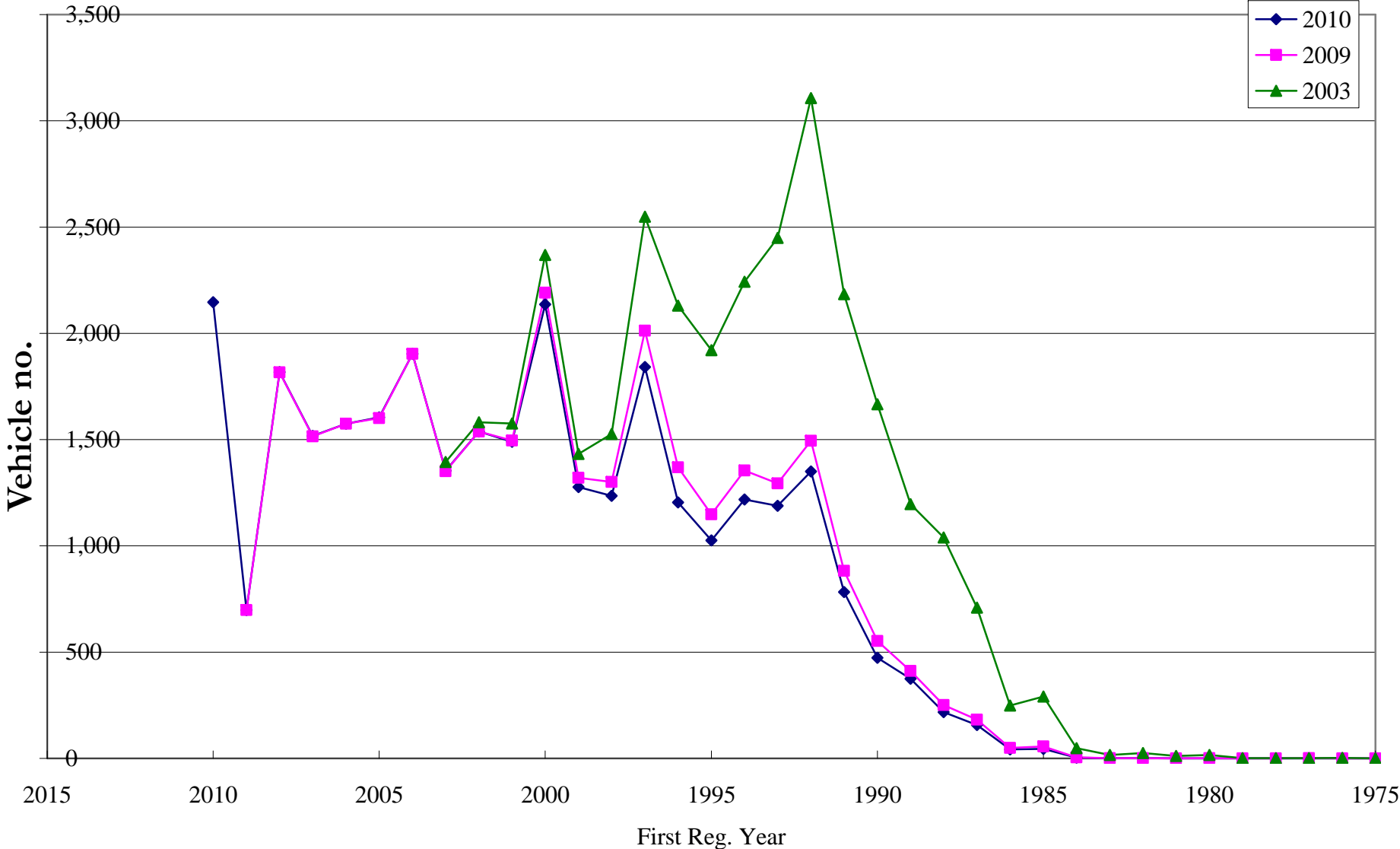
# Vehicular Activities

- Vehicle population - Local vehicle licensed data was used
- VKT - methodology in ATC was adopted with modification
- VKT by class - TD's methodology was adopted with modification
- speed fractions – VKT fractions by speed bins

The background of the slide is a blue gradient. The top portion shows a sky with light, wispy clouds. A horizontal line, representing a horizon, separates the sky from the lower portion of the slide. The lower portion is a solid, deep blue color with a subtle, fine-grained texture.

# Vehicle Population Distribution

# Distribution of Goods Vehicles > 15 t Population vs. 1<sup>st</sup> Reg. Year





# Estimation of VKT

# Counter Installation System in ATC

Type of Station	Frequency	Type of Counter Used	Duration of Measurement	Data Obtained
Core	Once a year	Recording	1 week in each of any 3 month	Daily & hourly directional flows
			1 week in each of the remaining 9 months	Daily & hourly non-directional flows
Coverage at cordon/ screenline	Once a year	Recording	1 week	Daily & hourly directional flows
Coverage not at Cordon/ Screenline	Surveyed twice in 5 years	Recording or non-recording	1 weekday (Mon-to-Fri)	Daily non-directional flows



# Distribution of Counting Stations in 2001 ATC

District	Type of Station	Road Network		Total
		Major	Minor	
Hong Kong Island	Core	30	6	36
	Coverage	122	49	171
	Total	152	55	207
Kowloon	Core	26	5	31
	Coverage	219	50	269
	Total	245	55	300
New Territories	Core	29	3	32
	Coverage	223	26	249
	Total	252	29	281
Total		649	139	788

# Road Types (1)

- Expressway (EX) and Urban (UT) / Rural (RT) Trunk Road
- Primary Distributor (PD)
  - form urban area's major network
- District Distributor (DD)
  - links districts to the PD

# Road Types (2)

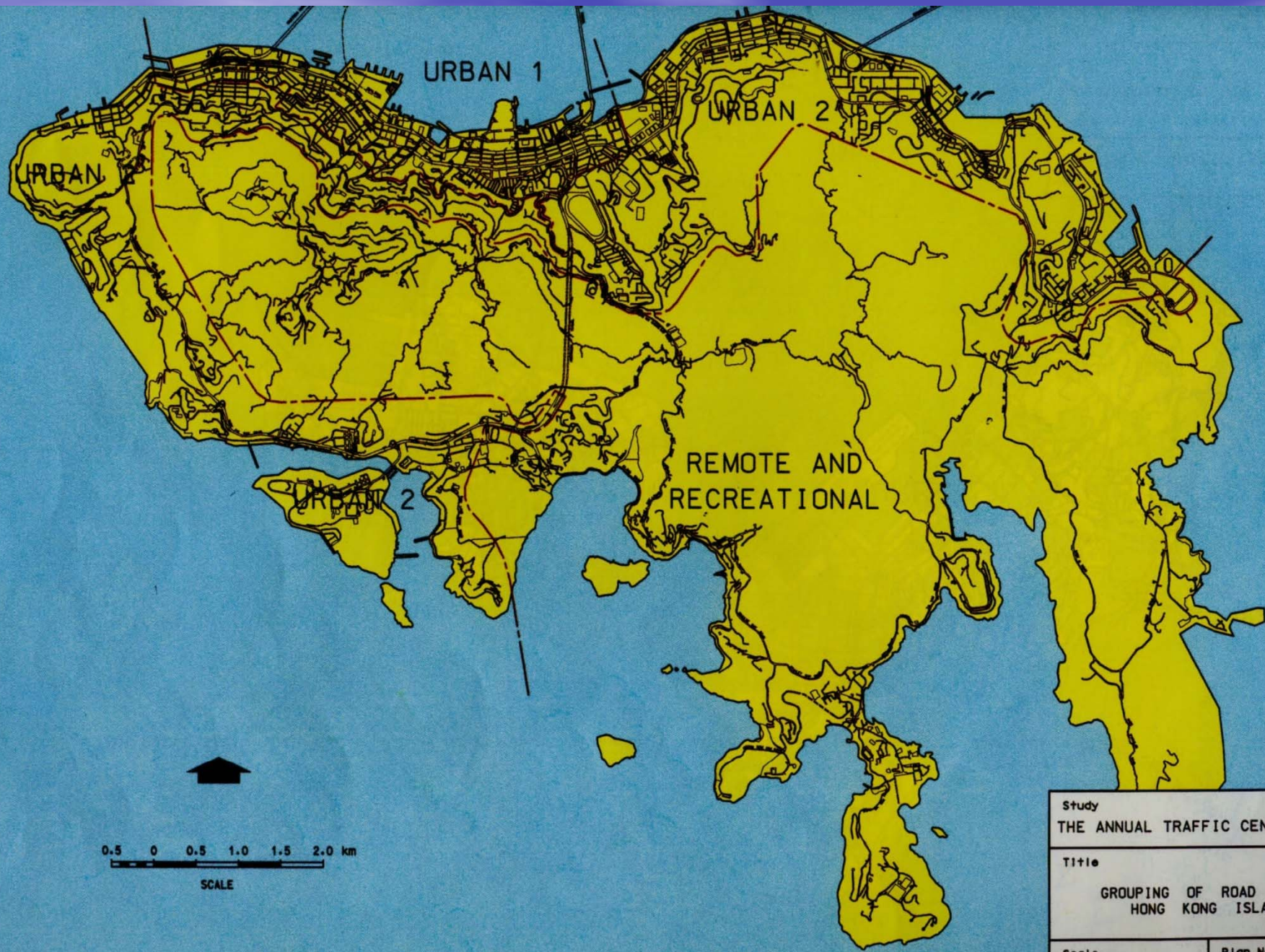
- Local Distributor (LD)
  - Roads within districts linking developments to DD
- Rural Road
  - Connects the smaller population centres/recreation areas with major road networks

# Road Link Groups (1)

- For coverage stations, AADT estimated by making use of the available information for the core stations.
- The core stations are clustered into groups based on the daily traffic pattern exhibited at each counting stations, called road link groups.

# Road Link Groups (2)

Region	Region	Road Link Group
Urban	Hong Kong	Urban 1
		Urban 2 (Major Road Network)
		Urban 2 (Minor Road Network)
	Kowloon	Urban 1
		Urban 2 (Trunk Roads and Primary Distributors)
		Urban 2 (District Distributors and Local Distributors)



0.5 0 0.5 1.0 1.5 2.0 km  
SCALE

Study THE ANNUAL TRAFFIC CENSUS	
Title GROUPING OF ROAD LINE HONG KONG ISLAND	
Scale AS SHOWN	Plan No. PLAN



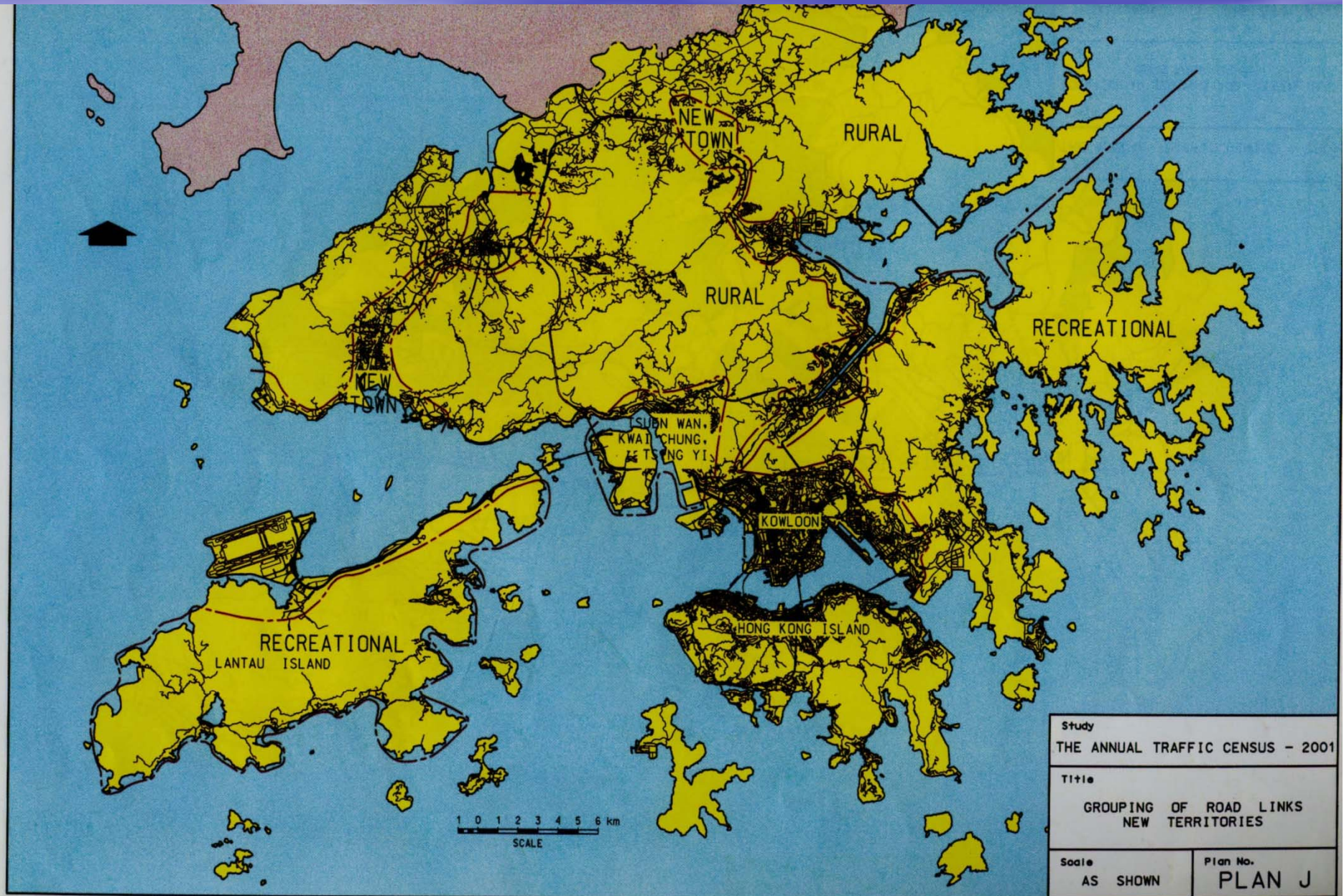
0.5 0 0.5 1.0 1.5 2.0 km  
SCALE

Study THE ANNUAL TRAFFIC CENSUS - 2001	
Title GROUPING OF ROAD LINKS KOWLOON	
Scale AS SHOWN	Plan No. PLAN I

# Road Link Groups (3)

Region	Road Link Group
Hong Kong	Remote & Recreational
New Territories	New Towns
	Tsuen Wan, Kwai Chung & Tsing Yi
	Recreational
	Rural





# Estimation of VKT (1)

- Major Road Network

The vehicle-kilometrage (VK) for each road link group ( $r$ ) for each major road type ( $t$ ) is

$$VK_{r,t} = \left\{ \sum_{\text{all core}} L_{i,\text{core},r,t} * AADT_{i,\text{core},r,t} \right\} + L_{\text{coverage},r,t} * \overline{AADT}_{\text{coverage},r,t}$$

# Estimation of VKT (2)

- Minor Road Network

The vehicle-kilometrage (VK) for each road link group ( $r$ ) for each minor road type ( $t$ ) is

$$VK_{r,t} = L_{r,t} * \overline{AADT}_{r,t}$$

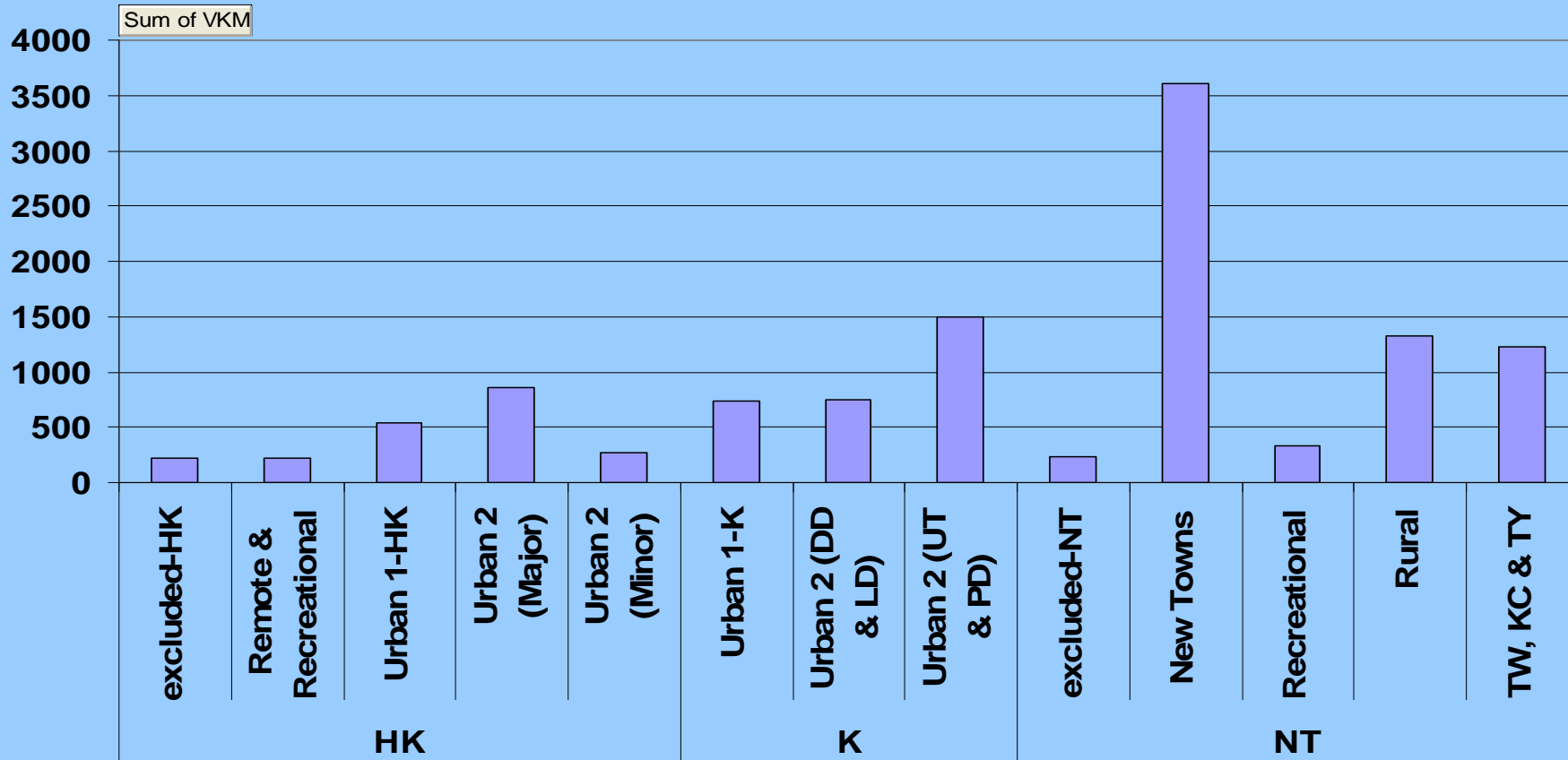
# Comparison of VKT in 2001



# VKT Distribution by Road Link Group in 2001

Year 2001

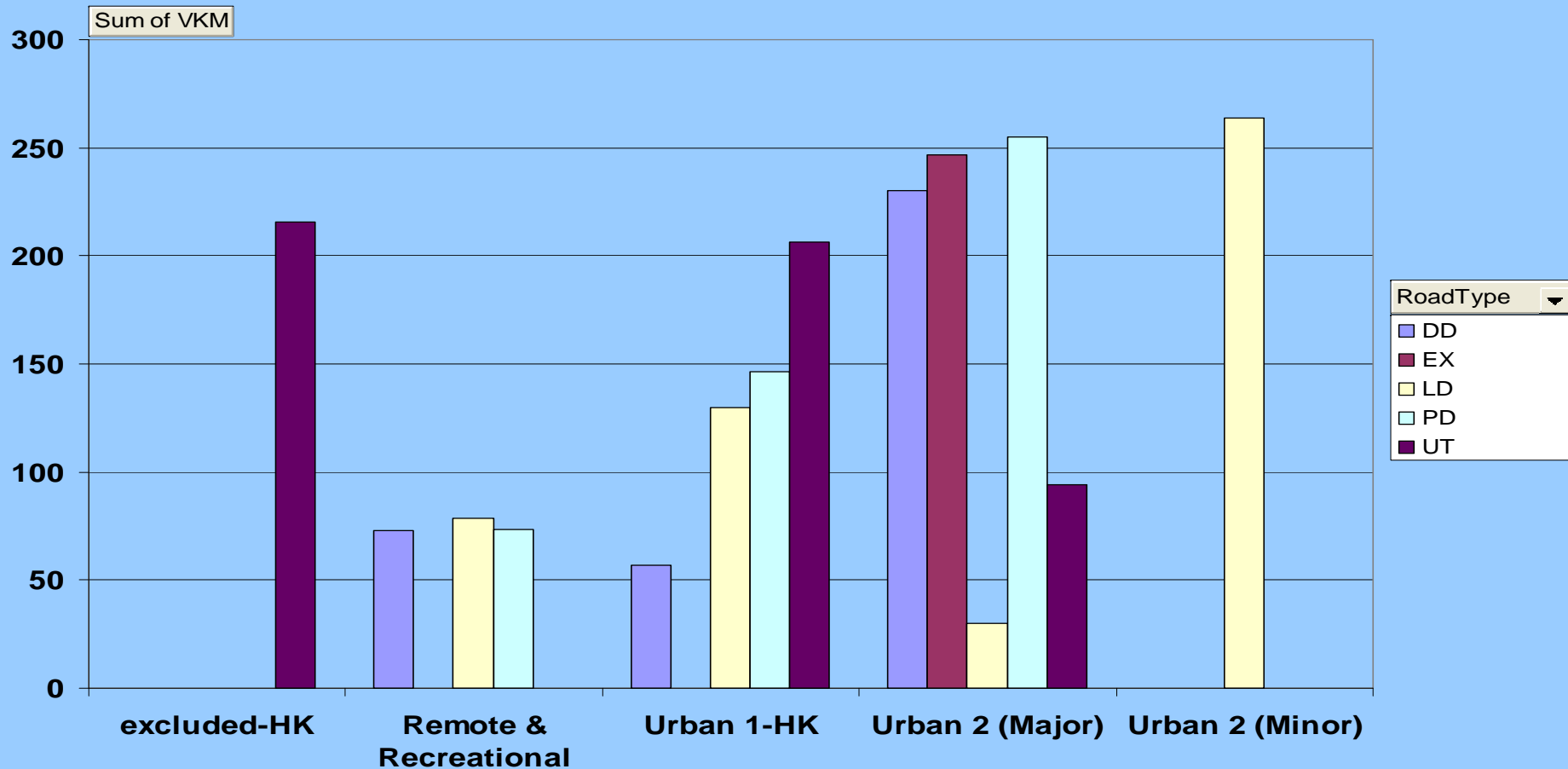
Drop Ser  
Total



Region RdLinkGp

# VKT Distribution by Road Link Group & Road Type in HKI in 2001

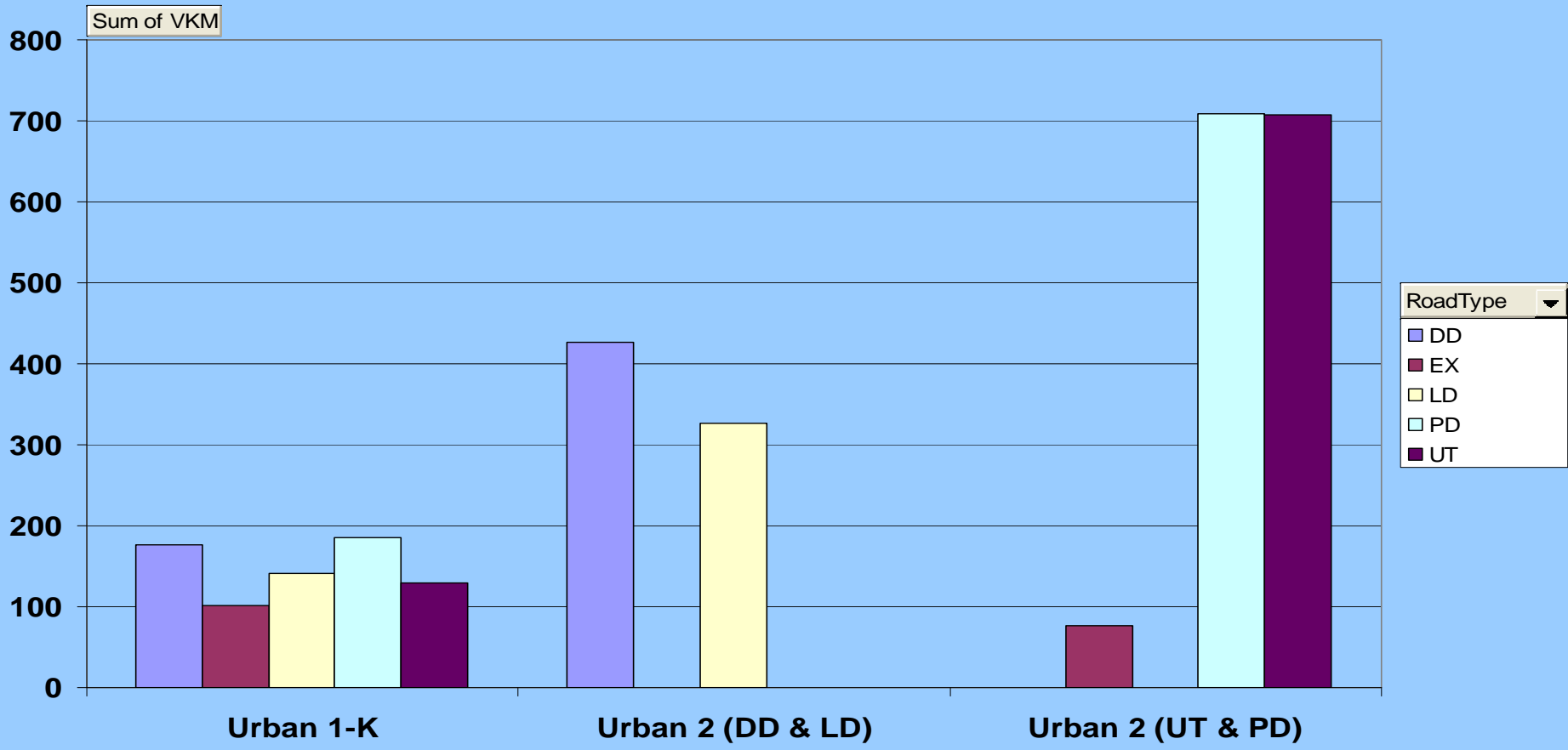
Year 2001 Region HK



RdLinkGp

# VKT Distribution by Road Link Group & Road Type in K in 2001

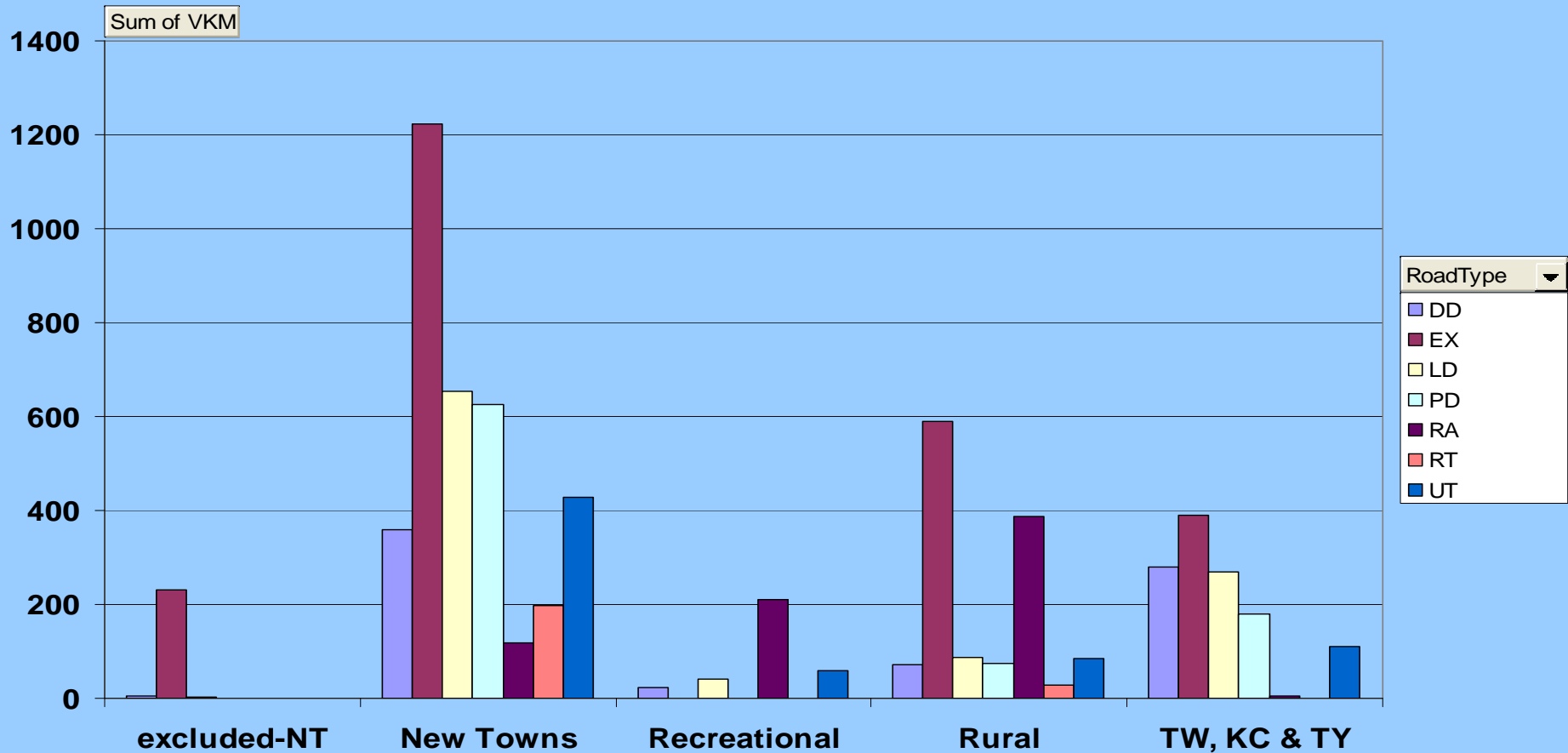
Year 2001 Region K



RdLinkGp

# VKT Distribution by Road Link Group & Road Type in NT in 2001

Year 2001 Region NT



RdLinkGp





# Estimation of VKT by Vehicle Class

# Vehicle Classification

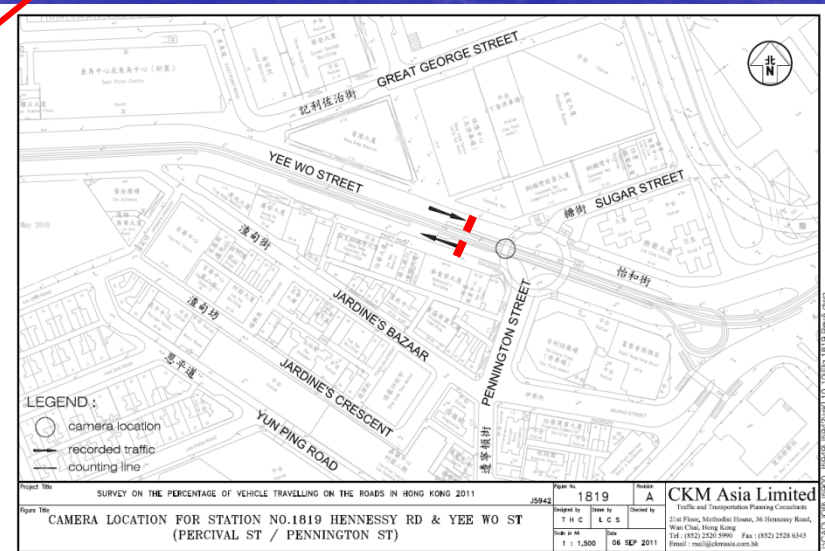
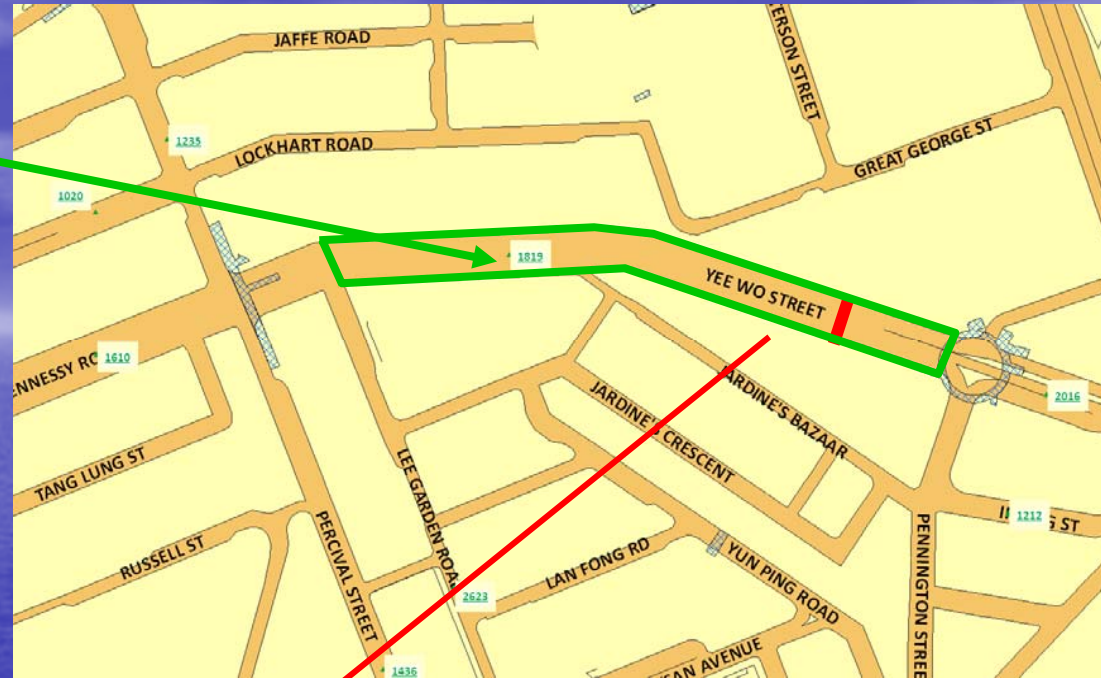
## Percentage of Vehicles by class

- obtained by manual counts for ~ 160 count stations (TD & EPD surveys)
- 24 hours
- one typical weekday each year
- at core stations and coverage stations falling on a cordon or screenline

# Traffic Counting Station locating on one of our proposed Low Emission Zones

(Yee Wo Street, Causeway Bay)

-Traffic flow before the implementation of low emission zone can then be monitored and evaluated.



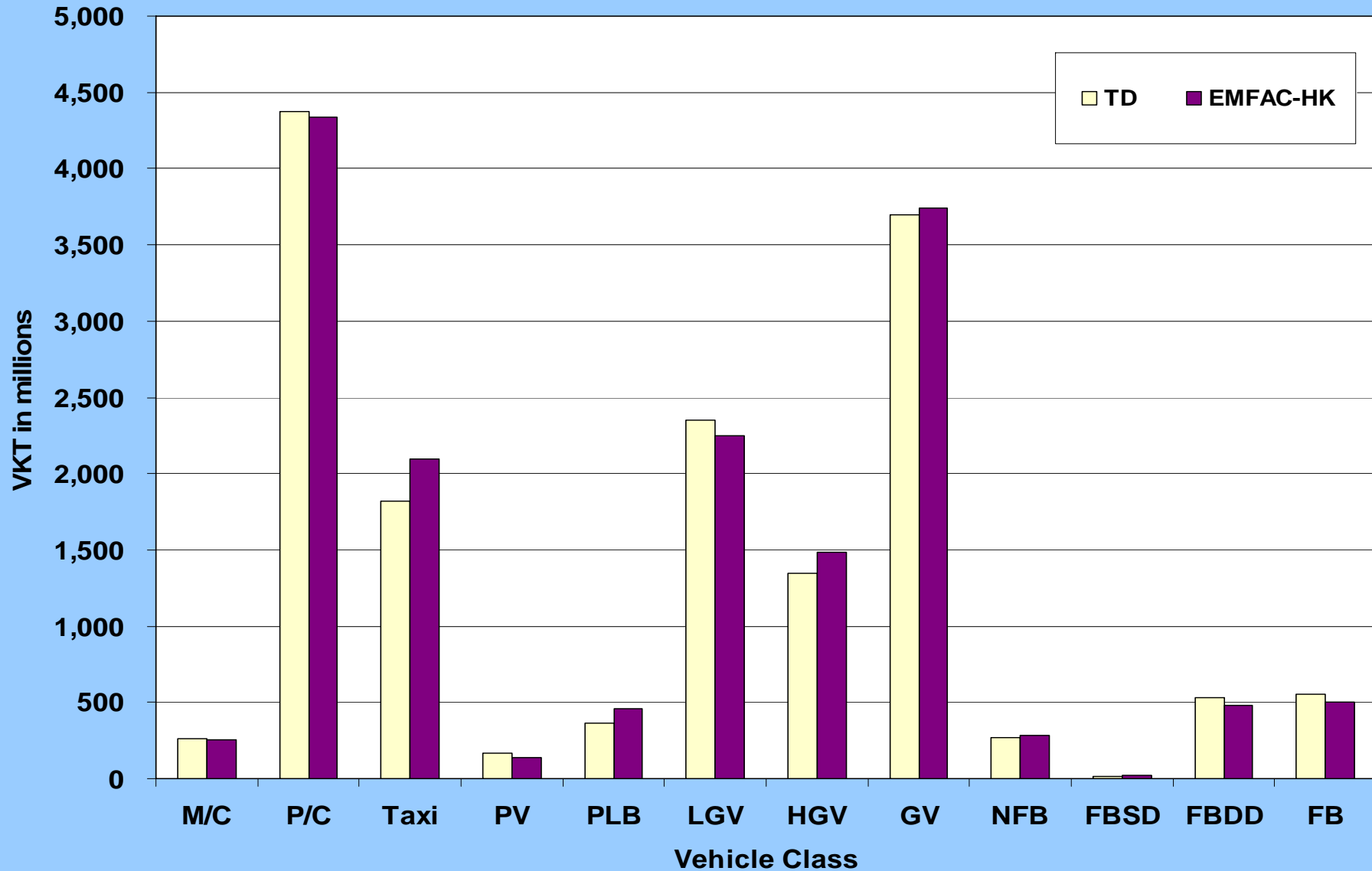
# Estimation of VKT by Class (e.g. taxi)

Traffic flow of taxi<sub>r,t,i,m</sub> at hr<sub>i</sub> at road type<sub>t</sub> at stn<sub>m</sub> in link group<sub>r</sub>

= (AADT \* % of taxi at hr<sub>i</sub>  
\* % of diurnal variation of traffic flow at hr<sub>i</sub>)

- lump together to give VKT by class
- provide diurnal variations of VKT

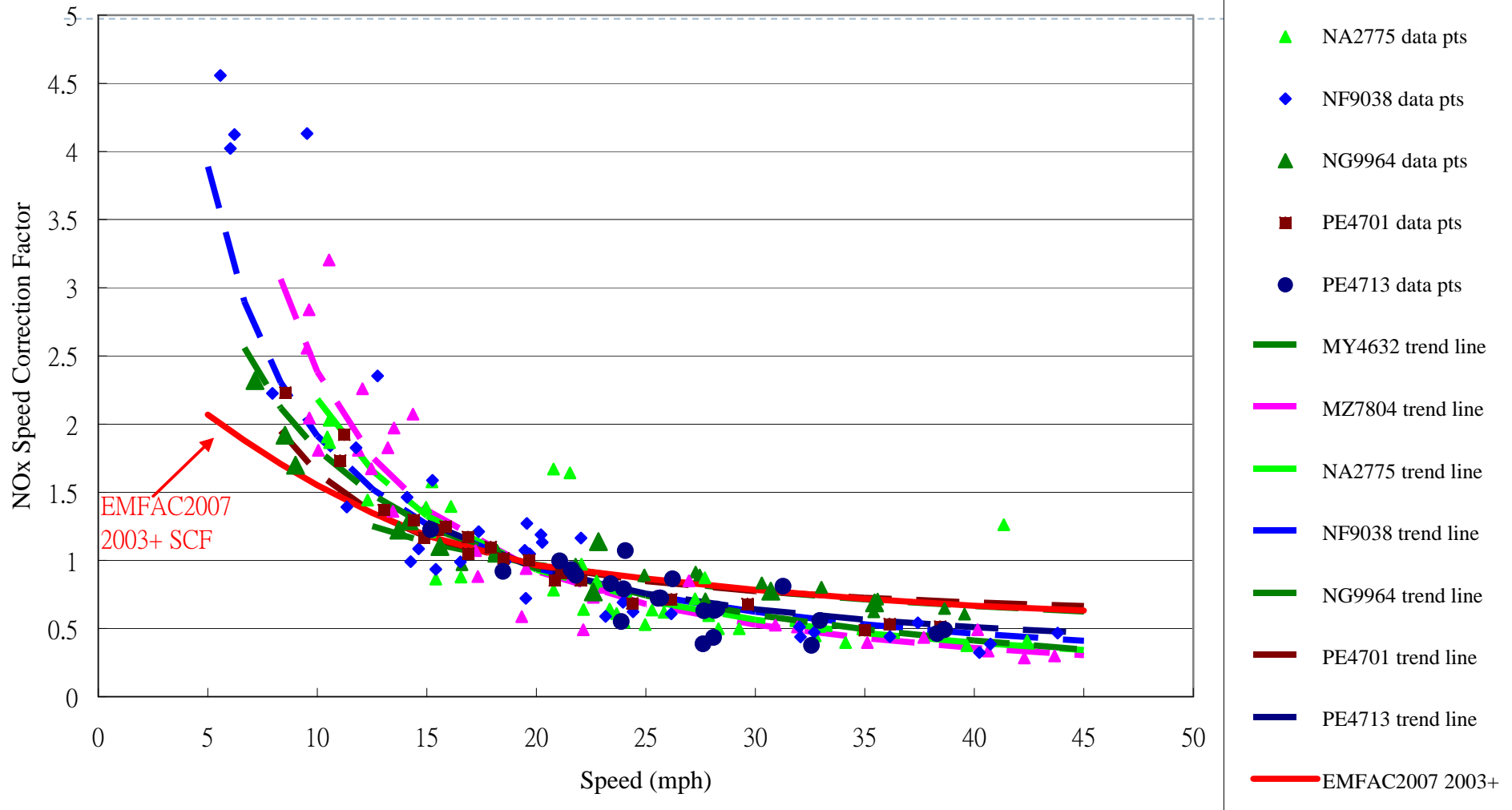
# Comparison of VKT in 2001





# Estimation of Speed Fractions

## NOx Speed Correction Factor for Euro IV Single Deck Coaches > 15 tonne



Each data pt is NOx emission factor averaged over 1-hour interval in this case

# Data Sources

- congested speeds at 0800-0930 from TD's Car Journey Time Surveys
- Speed limits (Highway Dept or TD)
- Speed vs. volume/capacity ratio from CTS-3



# Peak Hour (1)

Source –TD

AADT is not null at a station,  
Traffic volume in one direction, TV  
= segment Length x AADT / no of dirns

AADT is null at a station,  
Traffic volume in one direction, TV  
= segment Length x  $\overline{\text{AADT}}$  / no of dirns

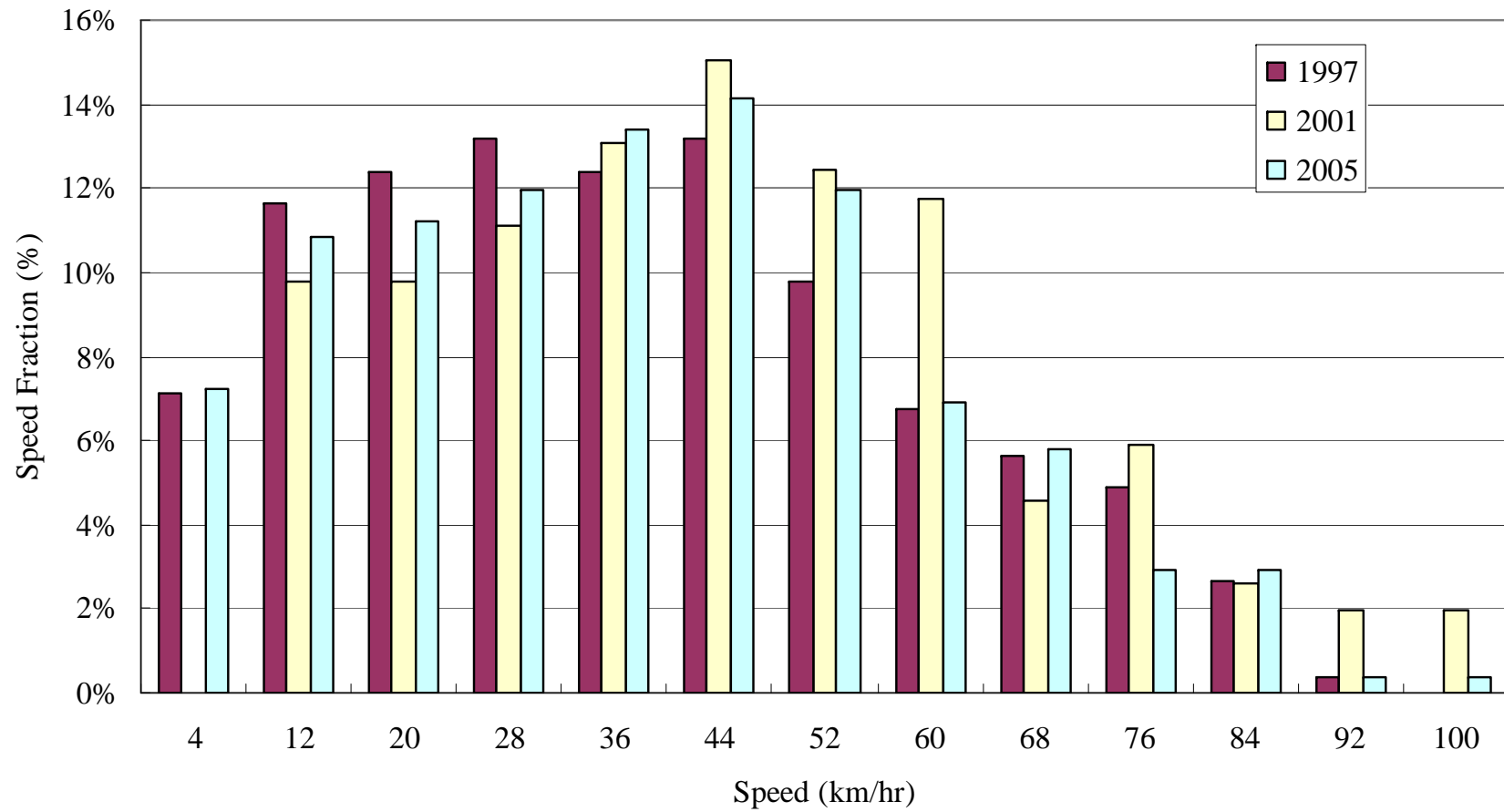
## Peak Hour (2)

VKT by class, region, linkgroup<sub>r</sub>, rdtype<sub>t</sub> and survey speed<sub>k</sub>, VKMx

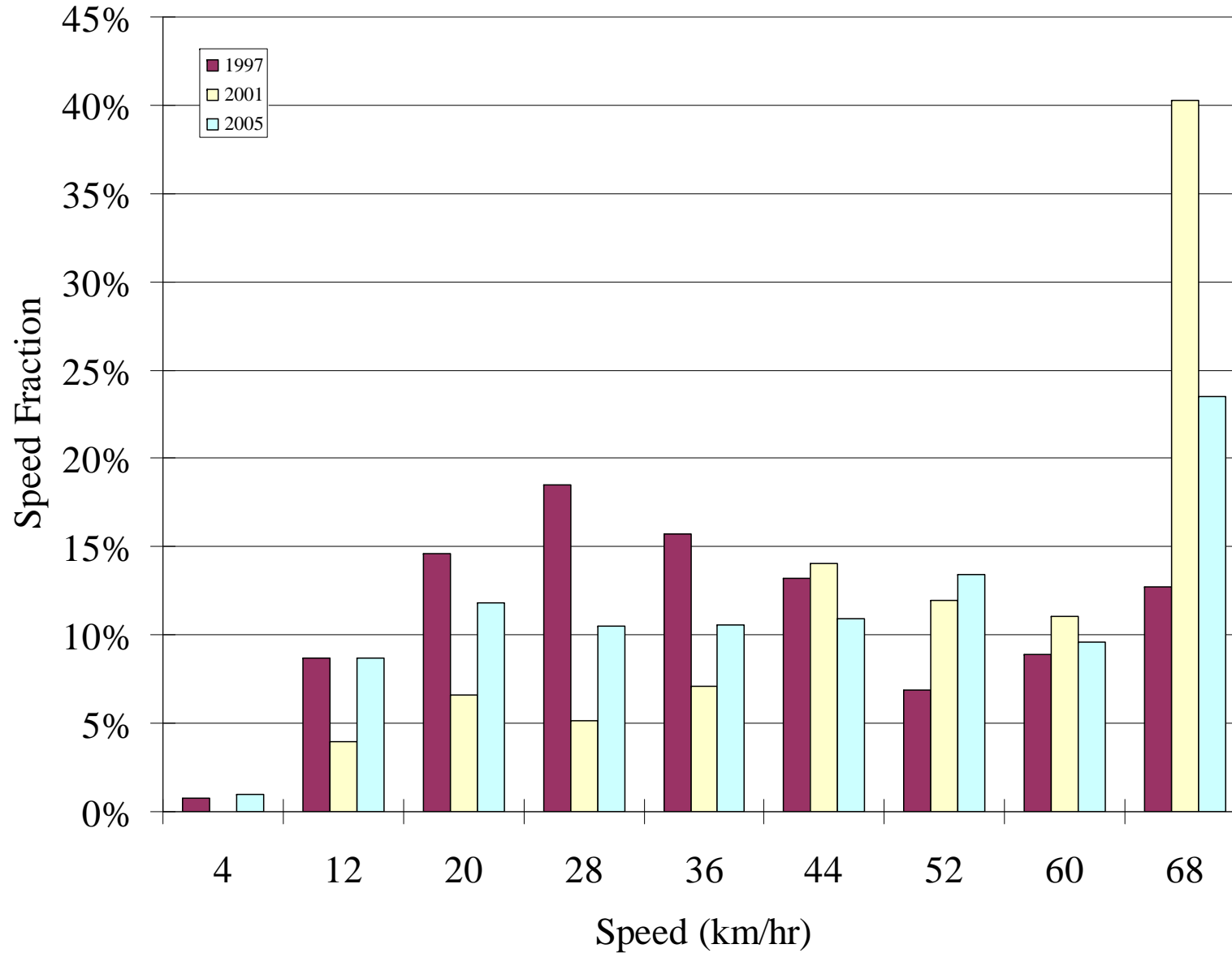
=VKT by class \* % Traffic volume in one direction at spd<sub>k</sub>

VKMx within a region then lump together to give speed fractions.

# Speed Fractions for Private Cars at Peak Hours



# Speed Fractions for Franchised Buses at Peak Hours

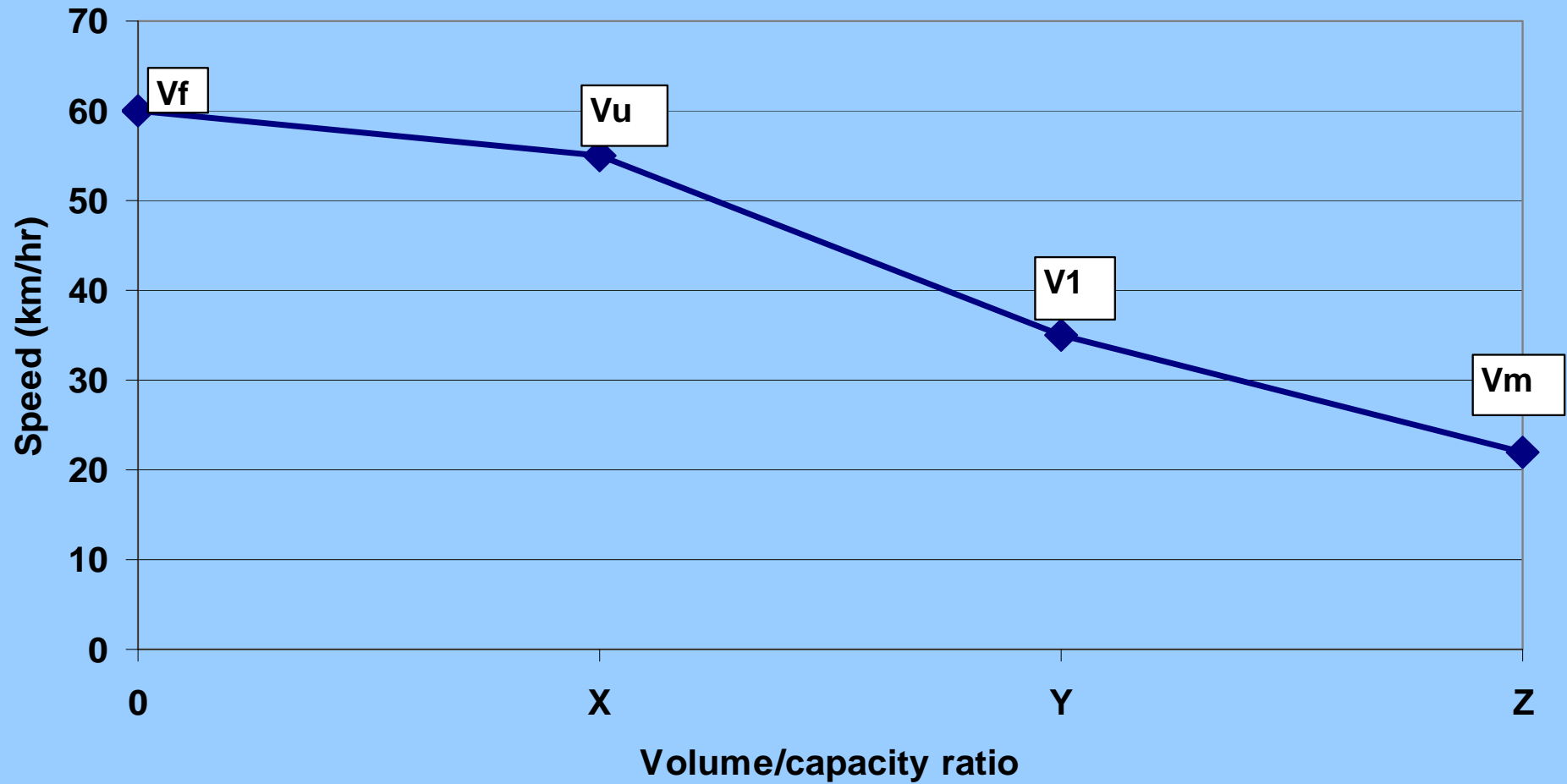


# Non Peak (1)

## Data Sources

- Speed limits (Highway Dept)
- Speed vs. volume/capacity ratio from CTS-3

# Link Speed Flow Curves



# Link Speed Flow Curves

Road Type	Vf	Vu	V1	Vm	X	Y	Z
Rural Road A	60	55	35	22	0.4	1.0	1.2
Rural Trunk Road	75	70	45	30	0.4	1.0	1.2
Urban Local Distributer	30	30	12	5	0.1	1.0	1.2
Urban District Distributer	40	40	22	11	0.1	1.0	1.2
Urban Primary Distributer	50	50	27	16	0.2	1.0	1.2
Urban Trunk Road	70	70	45	30	0.4	1.0	1.2
Expressway	90	85	65	40	0.4	1.0	1.2

# Passenger Car Unit Conversion Factors

Vehicle Type	PCU Conversion Factors
Car	1
Taxi	1
Bus	3
PLB	1.5
Light Van	1.25
Light Goods Vehicle	1.5
Medium Goods Vehicle	2
Heavy Goods Vehicle	2.5



## Non-Peak Hour (2)

- [avgMF] – average of traffic% in passenger car unit over each period by station
- $[avgMF] = veh\% * [MF] * PCU/100$
- $[maxMF] = veh\% * \text{a.m. peak hour traffic flow in passenger car unit} / AADT$

[MF] is found in TD's ATC

# Non-Peak Hour (3)

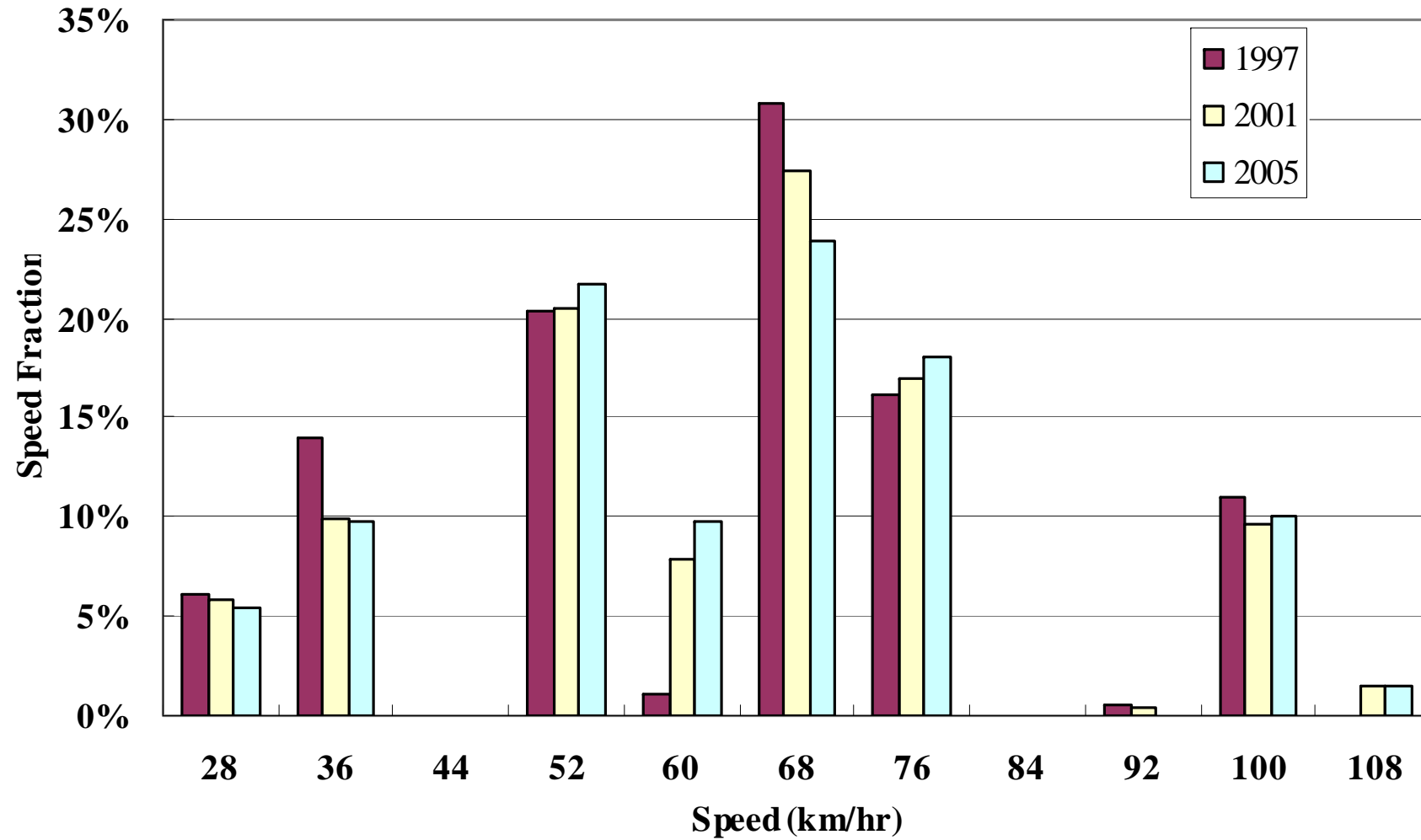
If speed limit = 50 km/hr, use congested speed to find volume/capacity ratio, VC ratio

- Congested speed > 50km/hr, use congested speed
- Congested speed  $\leq$  50km/hr:
  - Congested speed > free flow speed: use spd limit
  - Congested speed  $\leq$  free flow speed  
use  $VC_{nonPH} / VC_{congested}$   
 $= [avgMF] / [maxMF]$   
to calculate corresponding speed for non-PH

## Non-Peak Hour (4)

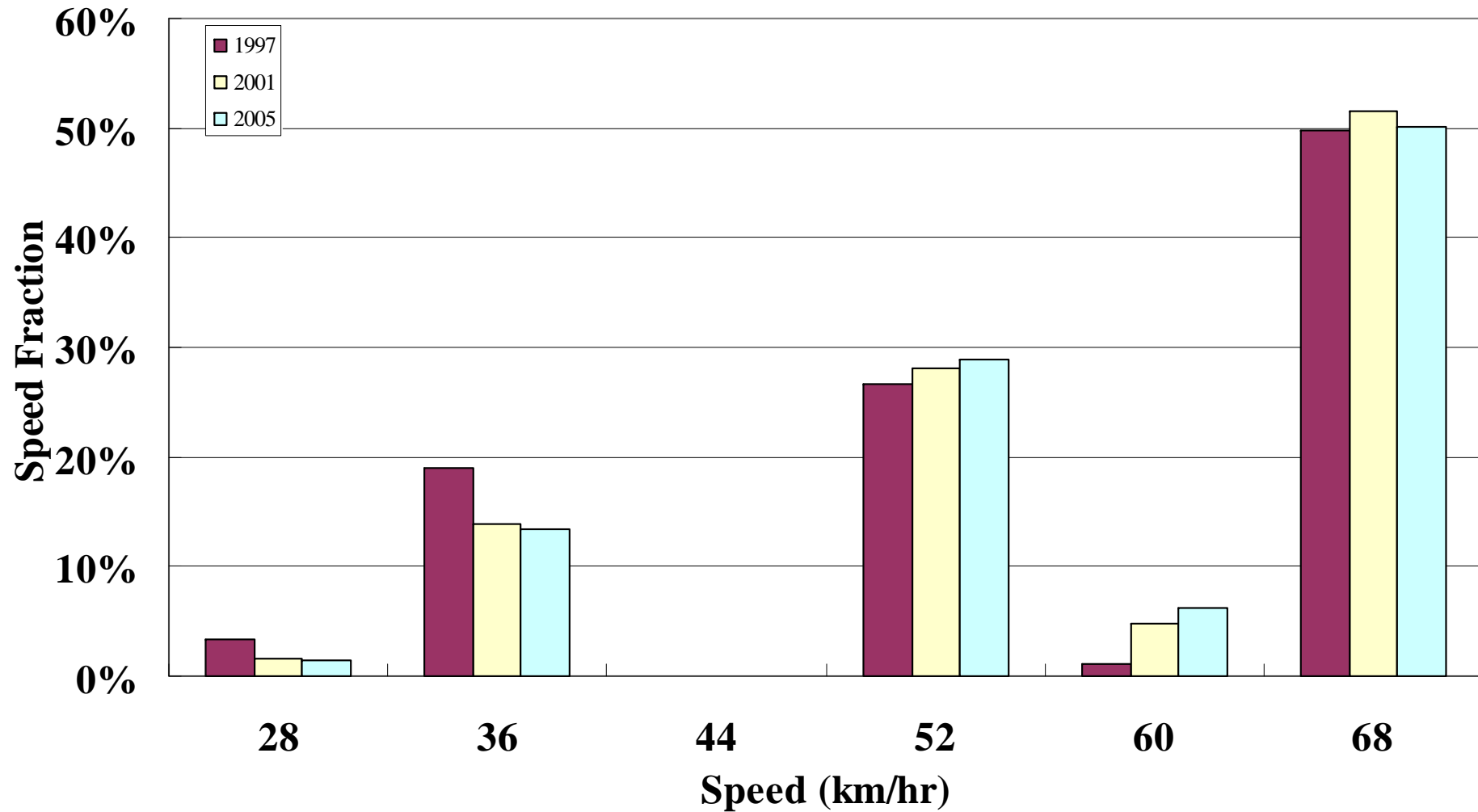
- If speed limit  $> 50$  km/hr, use speed limit.
- Calculation of speed fractions for non-peak daytime and non-peak nighttime was then similar to speed fractions at peak hour
- Will use the data obtained during vehicle emission measurements using PEMS

# Speed Fractions for Petrol Cars at Daytime non-peak Hours (using speed limit)



# Speed Fractions for Franchised Buses at Daytime non-peak Hours (using speed limit)

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Thank you.