

2nd. Asia Automobile Institute Summit

25-26 November 2013, Bali

Emission Factor Database Session

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Today's Agenda (Tentative)



Opening remark

- 1. Overview of vehicle emission measurements 15:05~15:20**
JARI, Japan
- 2. II. Current issues and future direction of emission testing and air pollution 15:20~16:00**
Ministry of Environment, Indonesia
CAERI, China
ARAI, India
TAI, Thailand
- 3. Discussion for future collaboration with participant countries 16:00~16:45**
- 4. Coordination for #3 AAI Summit 16:45~17:00**

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Overview of vehicle emission measurements

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Contents



- (1) Introduction: air quality and vehicle emission**

- (2) Vehicle emission measurements
for emission regulations**

- (3) Vehicle emission measurements
for real world emissions**

- (4) Proposal of JARI training
of emission measurements**

Various Sources of Air Pollution

Man-made emission sources



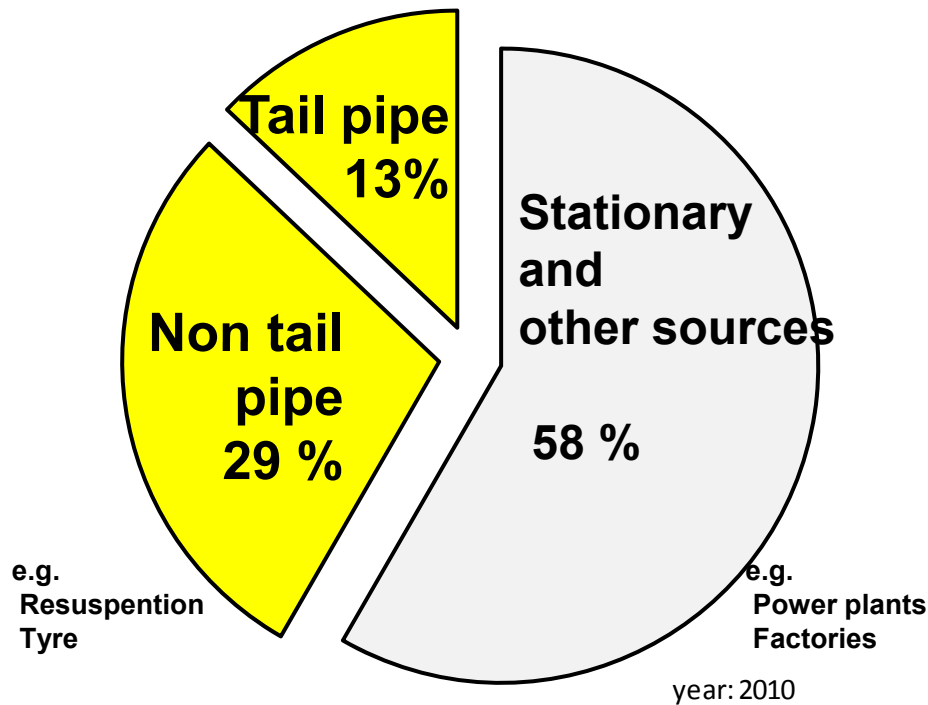
Natural emission sources



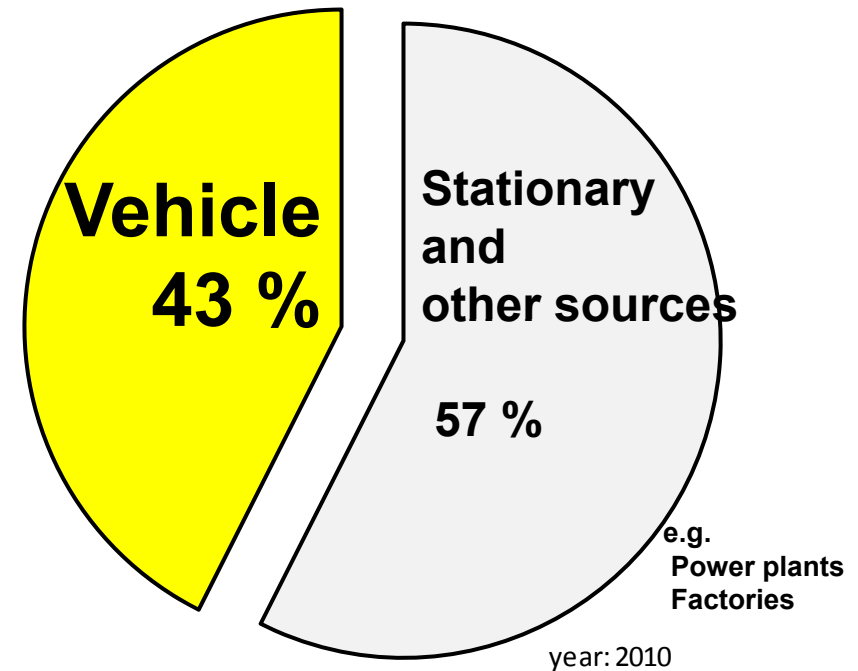
Annual emissions in Japan (2010)



PM emissions (Particulate Matter)

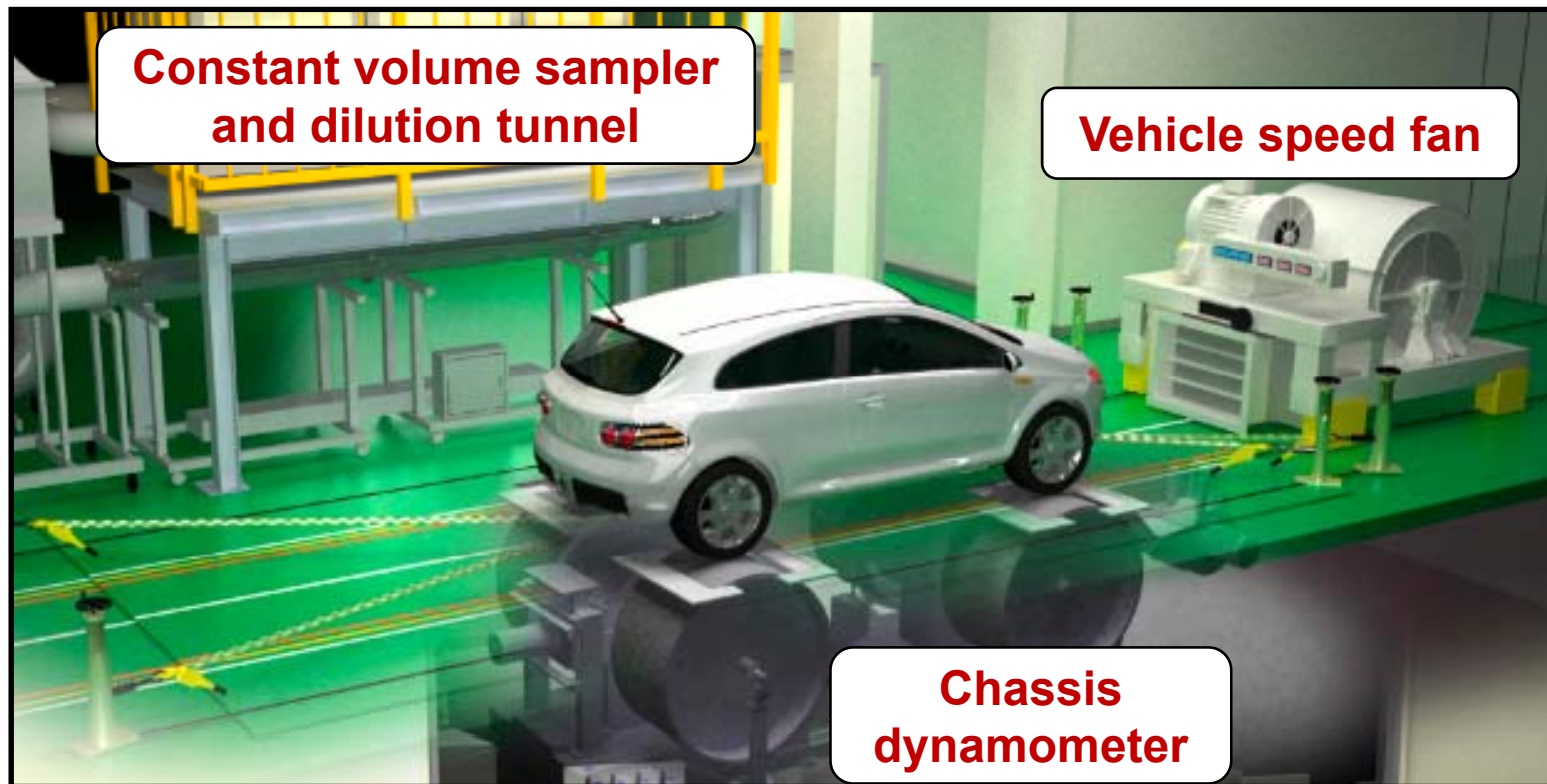


NOx emissions (Nitrogen Oxides)



Vehicle emissions are one of the major sources of urban air quality.

Chassis dynamometer (ChDy)



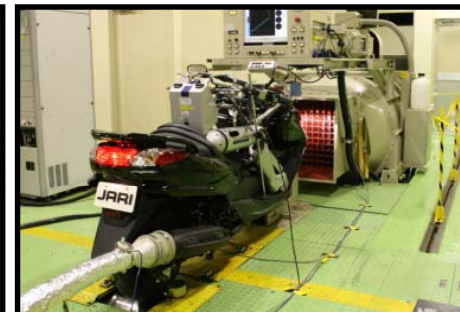
for LDV



for 4WD



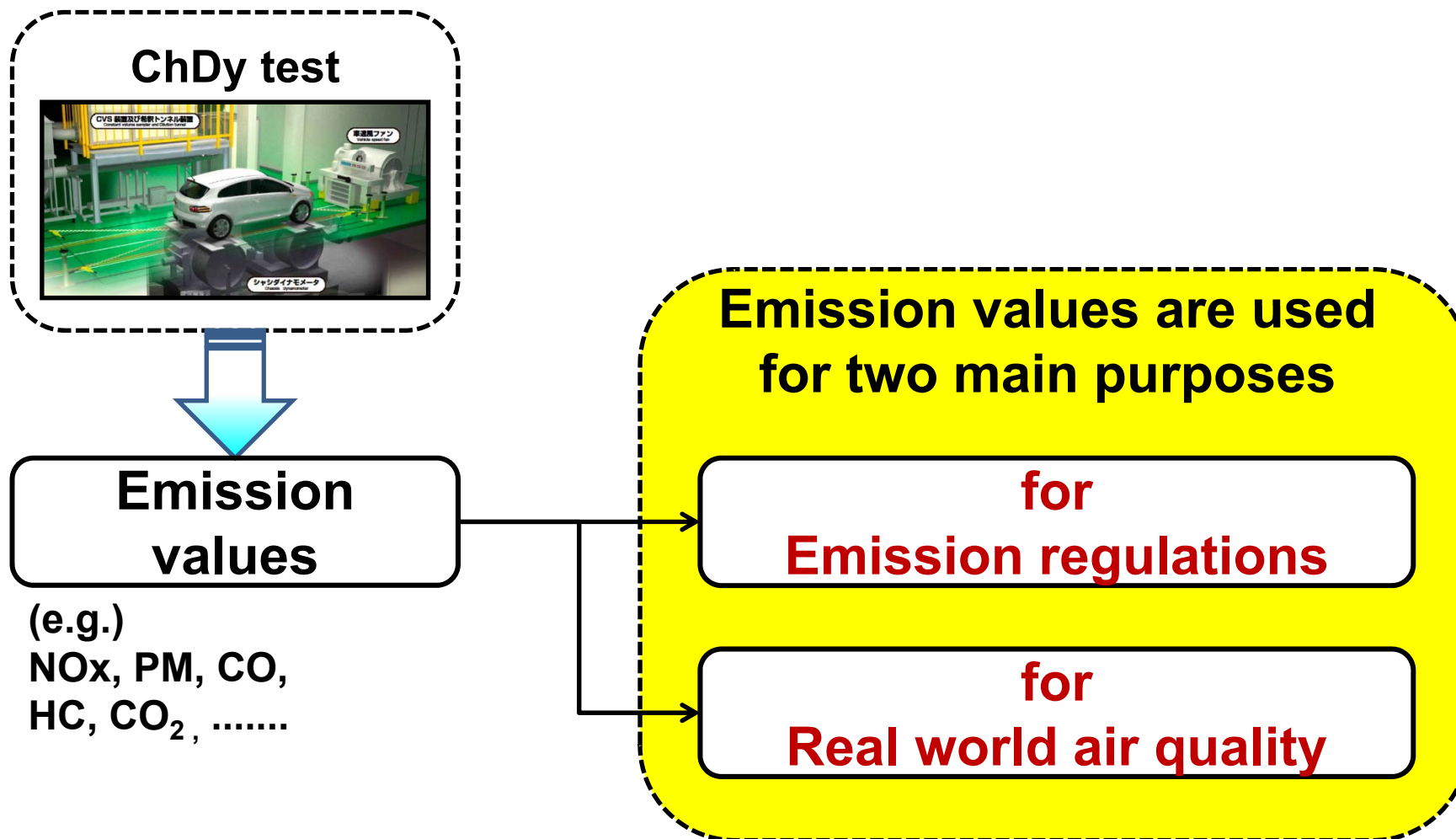
for motorcycle



for HDV



Vehicle emission measurement



Contents



(1) Introduction: Air quality and vehicle emissions

Short Summary

- Vehicle emissions are one of the major sources.
- Emission values are used for two main purposes:
 - (a) for emission regulations
 - (b) for real world air quality

(2) Vehicle emission measurement for emission regulations

(3) Vehicle emission measurement for real world emissions

(4) Proposal of JARI training of emission measurement

Vehicle emission measurement for emission regulations

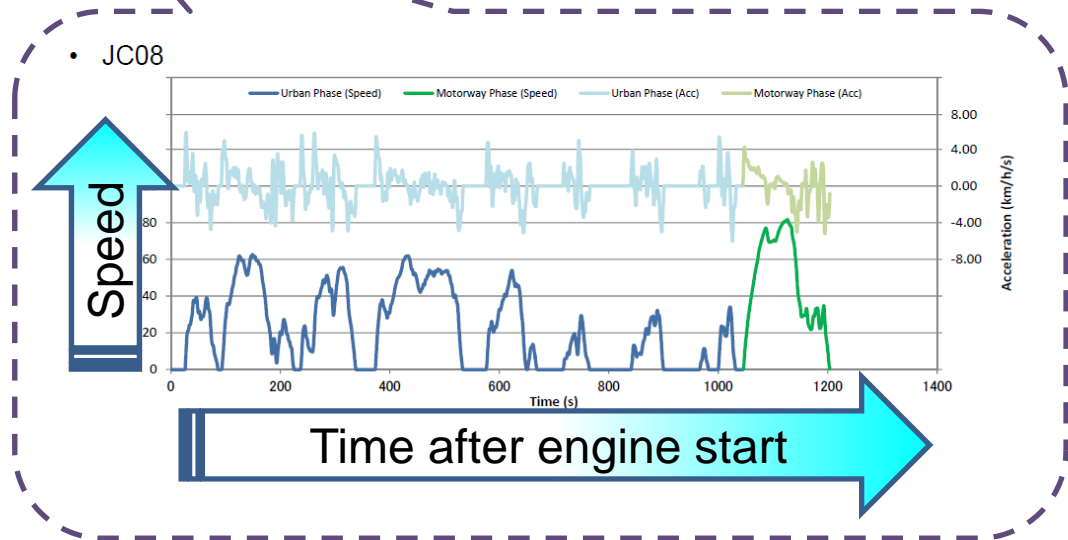


Regulation driving cycle

(e.g.) Japanese driving cycle for LDV

Emission values

(e.g.) NOx, PM, CO, HC,



Emission values are compared with the limit value of emission regulations.



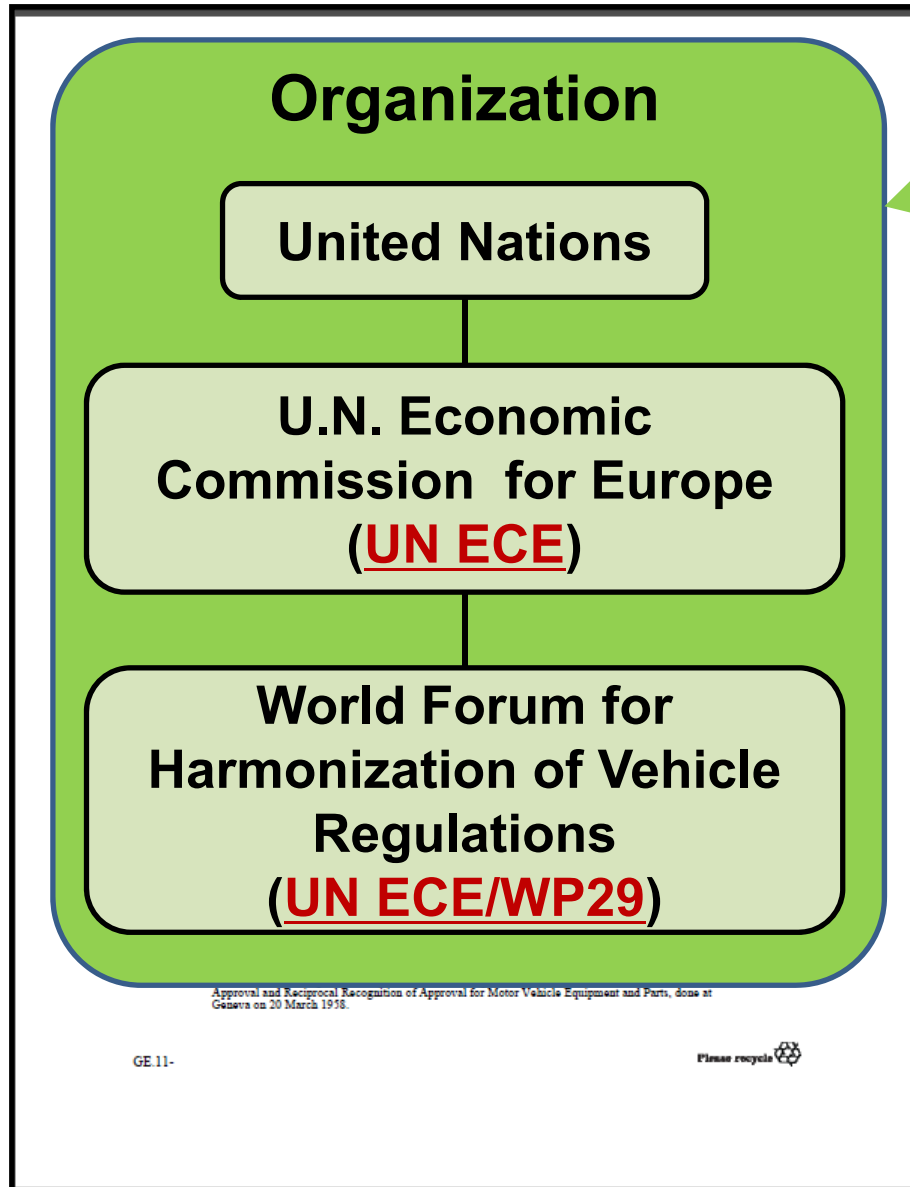
Difficulties of vehicle emission measurement for emission regulations



Difficulties:

- (a) There are a lot of rules and information in the test procedures.
- (b) There are important unwritten factors for test procedures and know-how for operation.

Difficulty (a): A lot of rules and information



(e.g.) UN ECE
Regulation No. 83

Regulation No. 83
Uniform provisions concerning the approval of vehicles with regard to the emission of pollutants according to engine fuel requirements

Contents

Main Part: pp. 1-37

Appendix: pp. 38-54

Annexes: pp. 59-253

Difficulty (a):
A lot of rules and information



Other UN ECE regulations for vehicle emissions

R24 engine power measurement, smoke emissions, engine type approval

R40 emission of gaseous pollutants by motorcycles

R47 Moped Emissions

R49 Diesel and CNG/LNG Engine Emissions

R67 Liquefied Petroleum Gas Equipment

R83 emission of pollutants according to engine fuel requirements

R84 measurement of fuel consumption

R85 electric drive trains

R101 measurement of the emission of carbon dioxide and fuel consumption

R103 Replacement Catalytic Converter

R110 Compressed Natural Gas System Components

R115 Liquefied Petroleum and Compressed Natural Gas Retrofit Systems

**There are a lot of regulations.
Each regulation has a lot of rules and information.**

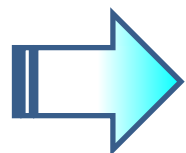
Difficulty (b):

Important unwritten factors and know-how for operation.

Example:

- **Pre-conditioning** of test cars before ChDy test.
- Maintenance of **sampling lines**
- Maintenance of **dilution tunnels**
- Handling of **sampling filters for PM** collection
- Analysis method of **unregulated** chemical species

Since exhaust gases are getting **cleaner**, these actions become important **to keep accuracy, precision and repeatability** of the ChDy test.



JARI proposal of ChDy training for improving engineers' knowledge

Contents



(1) Introduction: Air quality and vehicle emissions

(2) Vehicle emission measurement for emission regulations

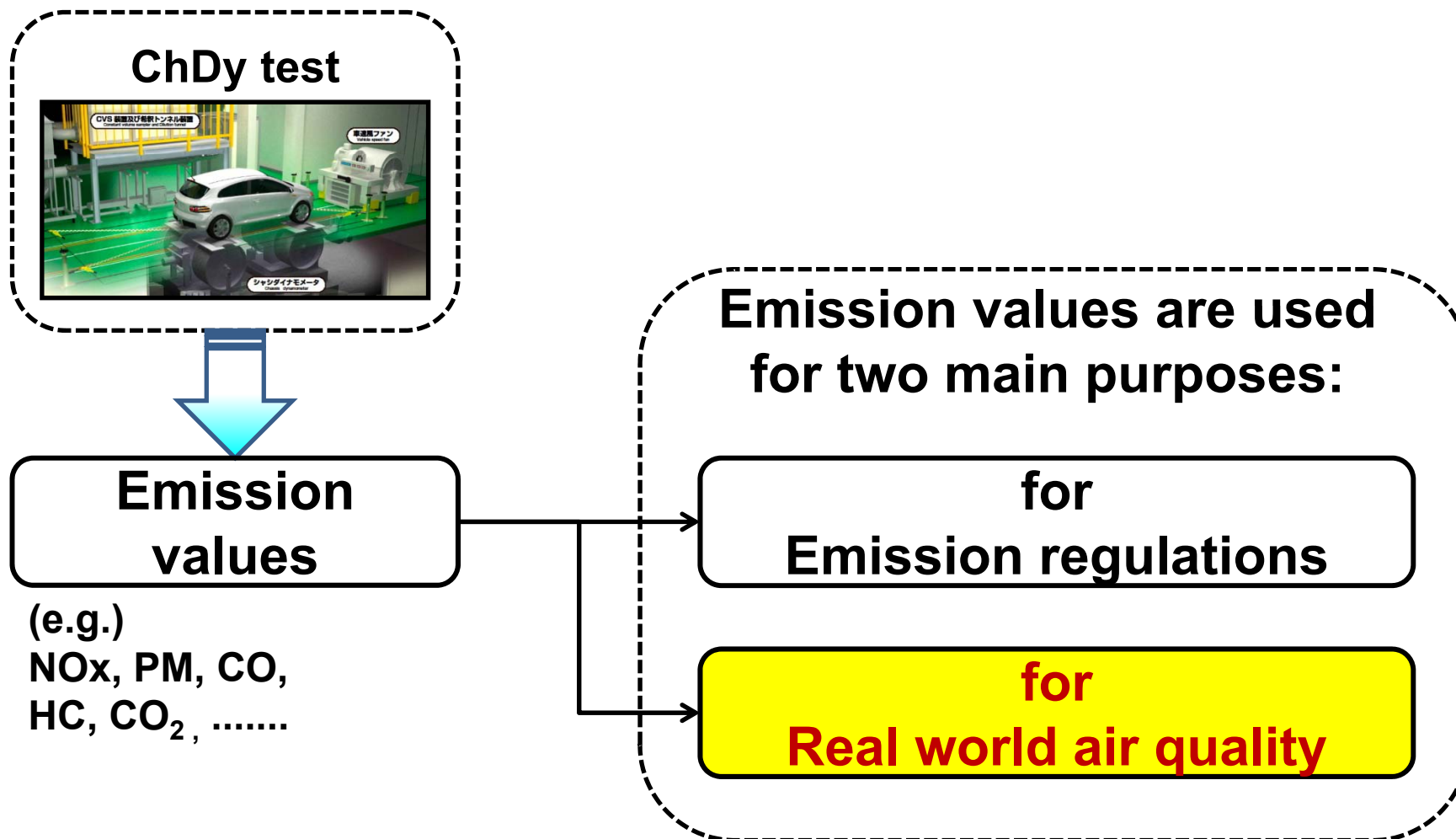
Short summary

- There are a lot of **rules**, **information**, important **unwritten** factors and **know-how** in ChDy test.
- It is important to keep **accuracy**, **precision** and **repeatability** of ChDy tests.

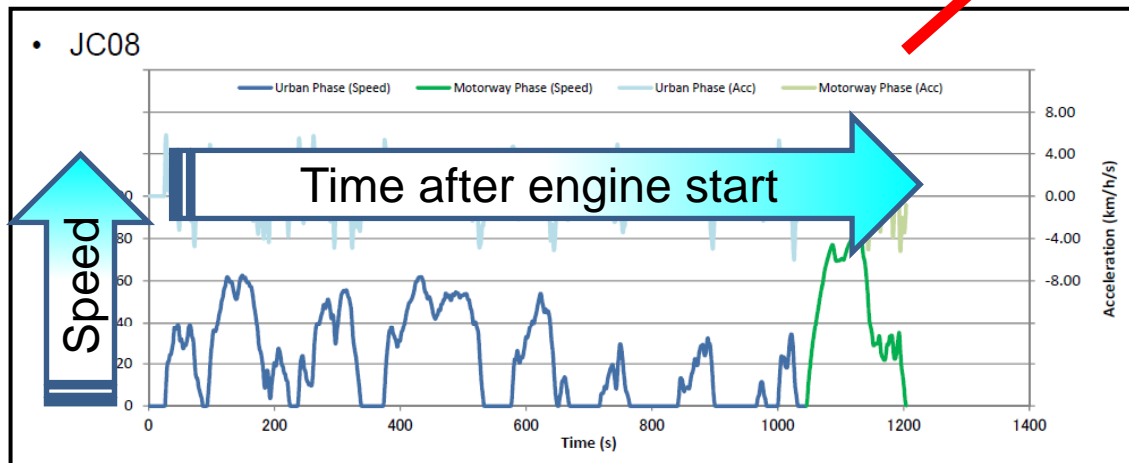
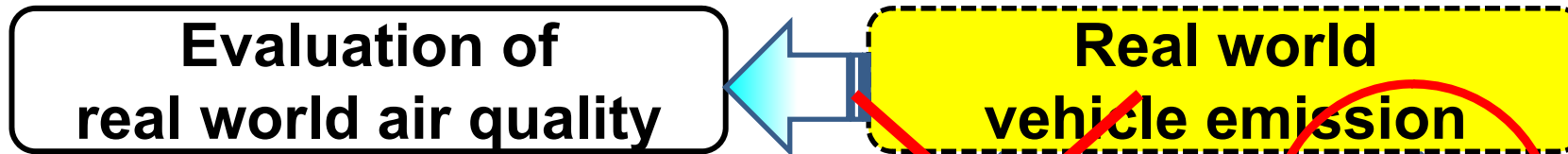
(3) Vehicle emission measurement for real world emissions

(4) Proposal of JARI training of emission measurement

Vehicle emission measurement



Difference of emissions between test driving cycle and real world driving



The accumulation of emission data of driving patterns at various mean vehicle speeds is necessary to obtain real world vehicle emissions.

Estimation of real-world vehicle emissions

ChDy data accumulation
@ various mean vehicle speeds



Emission factor
- vehicle type
Gasoline/Diesel
LDV/HDV
Euro 2, 3, 4, 5
- NO_x, PM, CO, HC, CO₂

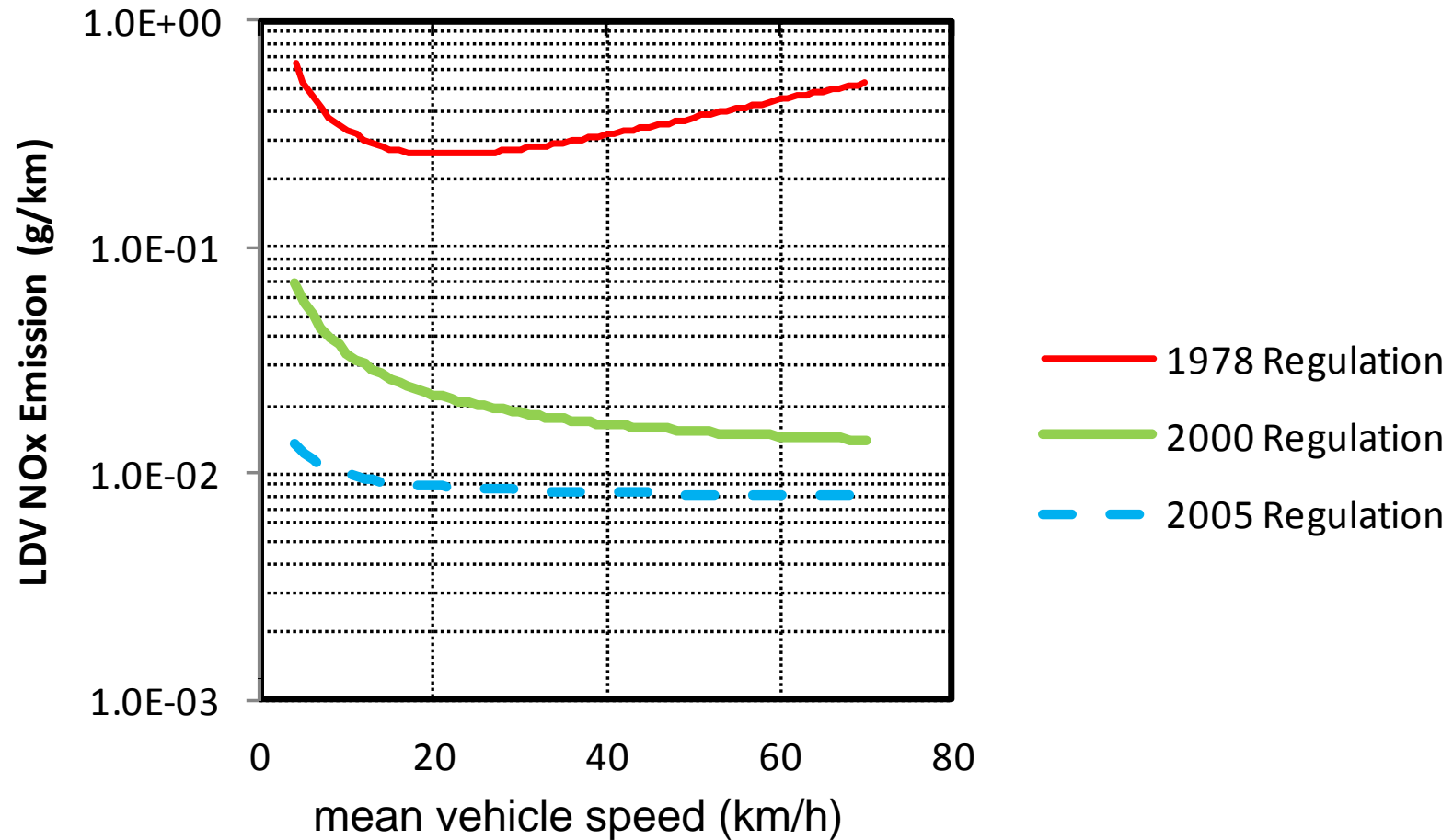


Real world vehicle emissions

Emission factor



(e.g.) NO_x emission factor (g/km) for light-duty vehicles



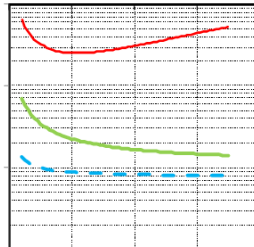
Estimation of real-world vehicle emissions

ChDy data accumulation
@ various mean vehicle speeds



Emission factor

- vehicle type
Gasoline/Diesel
LDV/HDV
Euro 2, 3, 4, 5
- NO_x, PM, CO, HC, CO₂



Statistical data

- Traffic volume
(vehicle type, weekday/holiday)

Estimation data

- Vehicle age, load, vehicle speed

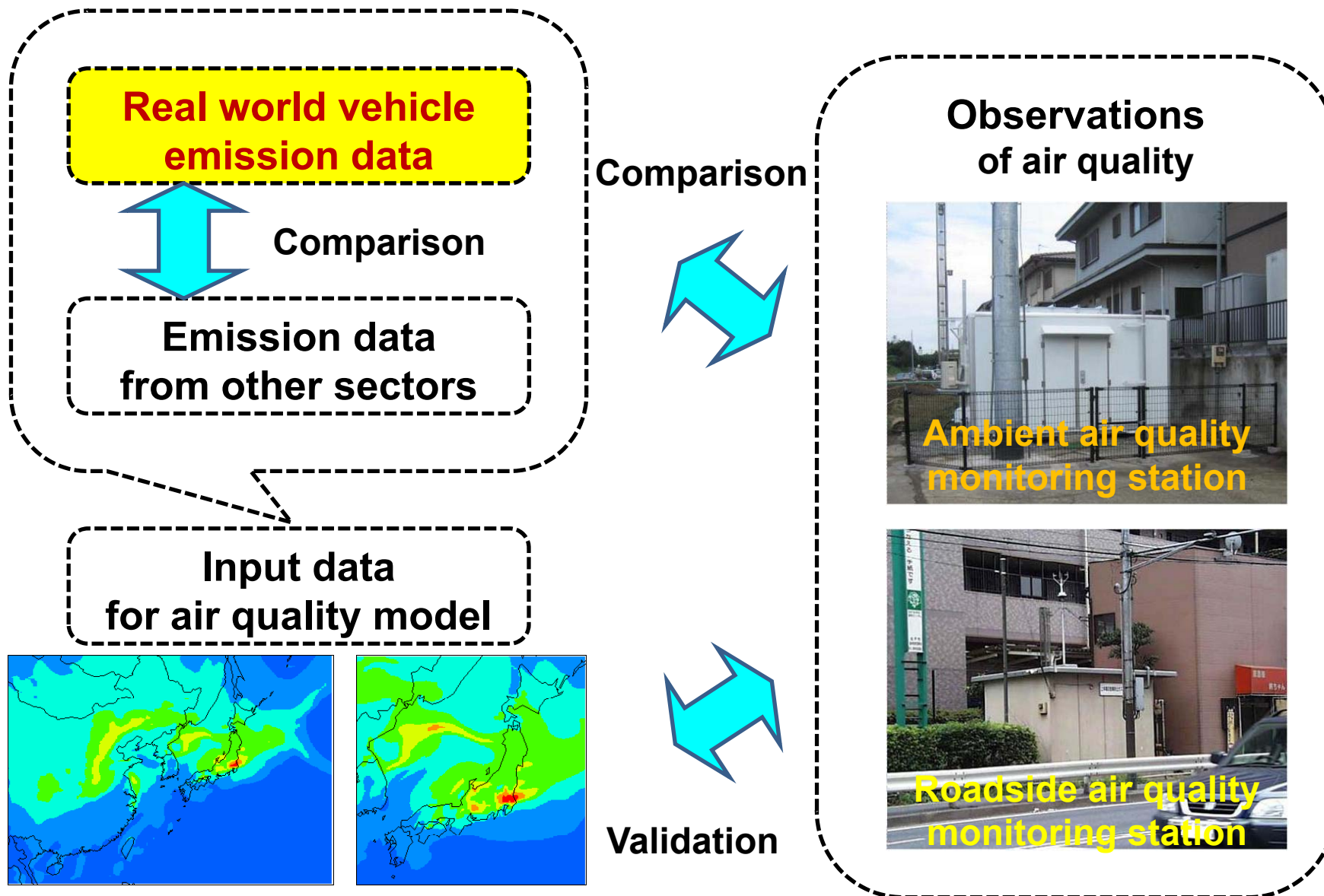
Environmental data

- Average temperature, humidity



Real world vehicle emissions

Usage of real world emission data



Contents



(1) Introduction: Air quality and vehicle emissions

(2) Vehicle emission measurement for emission regulations

(3) Vehicle emission measurement for real world emissions

Short summary

- For each vehicle emission factor, many ChDy data at various mean vehicle speeds are necessary.
- Combination of emission factor and other statistical data creates real world vehicle emission.
- The real world vehicle emissions can be used for policy making.

(4) Proposal of JARI training of emission measurement

Schedule for C/D Training in JARI (Lecture)



Day	Time	Contents	Hotel location
Day-1: Thu.	AM	Test method of emission gas and regulation trends	JARI
	PM		
Day-2: Fri.	AM	Outline of test equipment and theory	JARI
	PM		

Schedule for C/D Training in JARI



Day	Time	Contents	Hotel location
Day-3: Mon.	AM	Preparation for test vehicles	JARI
	PM		
Day-4: Tue.	AM	Setting the test vehicles	JARI
	PM	Setting running resistance or pre-conditioning driving	
Day-5: Wed.	AM	Demonstration	JARI
	PM		
Day-6: Thu.	AM	Practice	JARI
	PM	Test and data processing	
Day-7: Fri.	AM	Removal of test vehicle and report	JARI
	PM	Summary	

Summary

(1) **Vehicle emissions** are one of the major sources of poor urban air quality.

(2) In ChDy tests, there are a lot of rules, information, important unwritten factors and know-how.

It is important to keep accuracy, precision and repeatability of ChDy tests.

(3) The real world vehicle emissions can be created by the combination of emission factor and other statistical data, and used for policymaking.

(4) JARI ChDy training proposed here includes a 2-day lecture and a 5-day ChDy practice.

The training is effective to improve Asian engineers' knowledge and technological skills.

Thank you.

**If you have any comments and questions,
please feel free to contact us:**

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Backup Slide

Example of air quality monitoring stations

Ambient

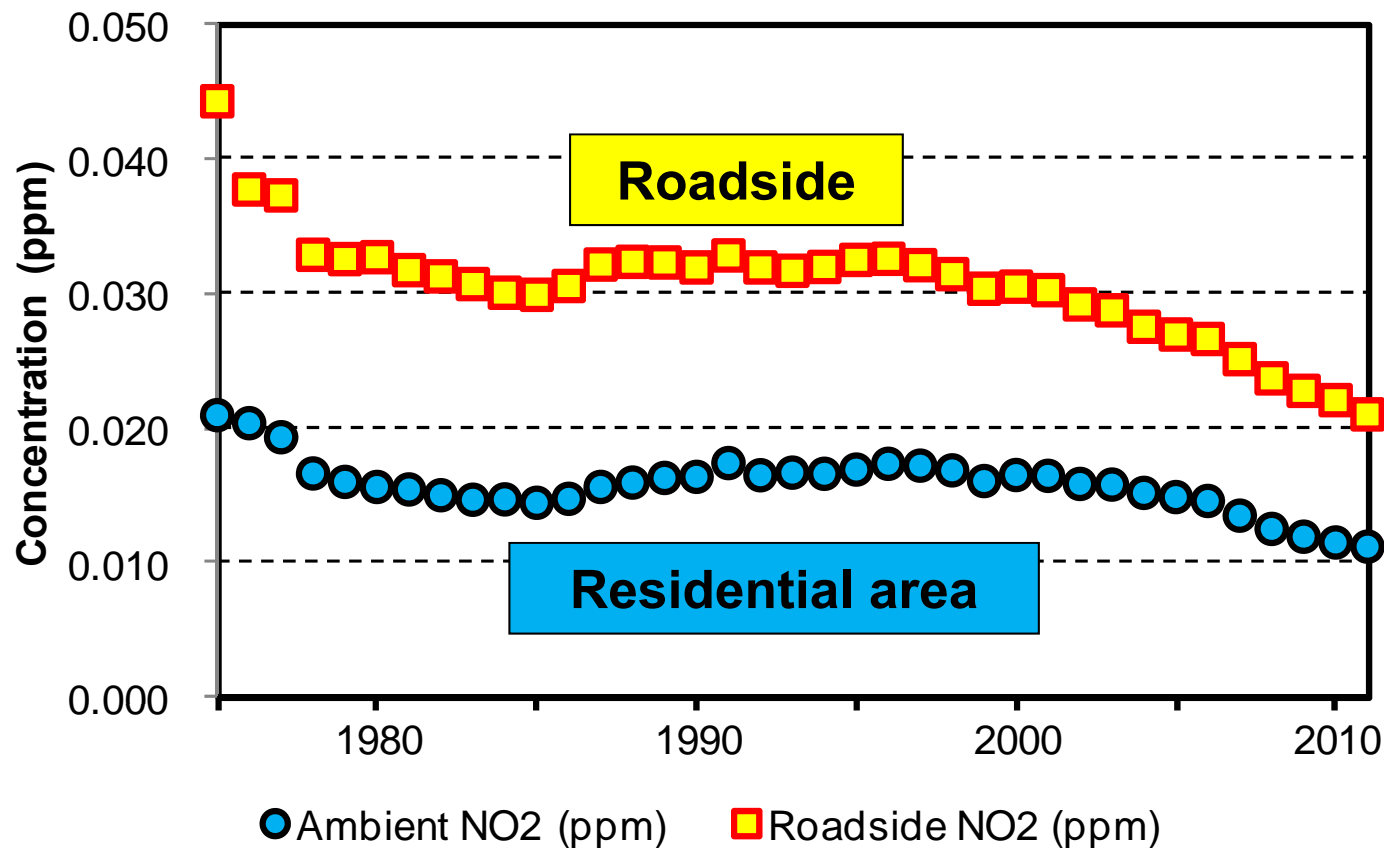


Roadside



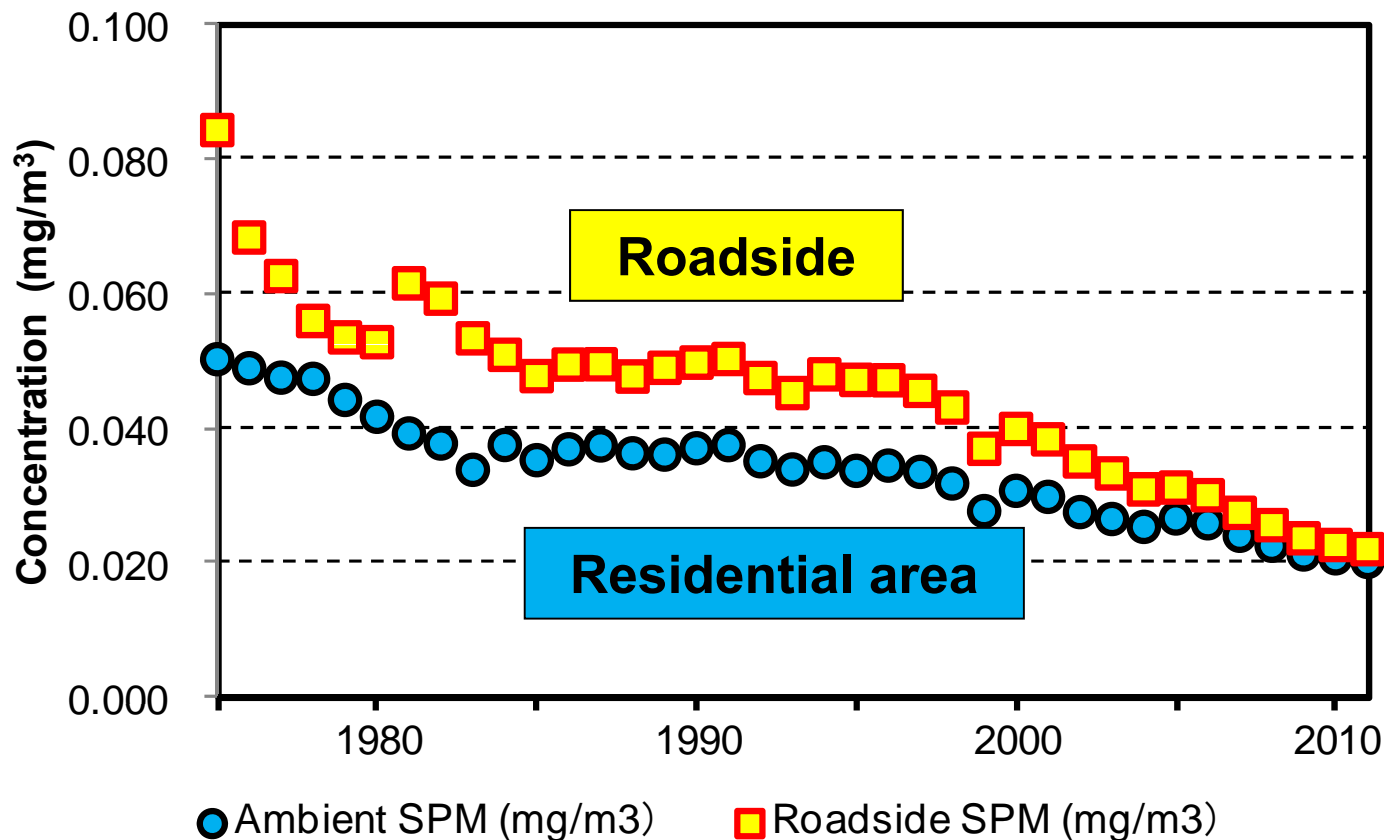
Annual average **NO₂** concentrations (Nitrogen Dioxide)

Unit Conversion of NO₂
0.01 ppm = 19 µg/m³



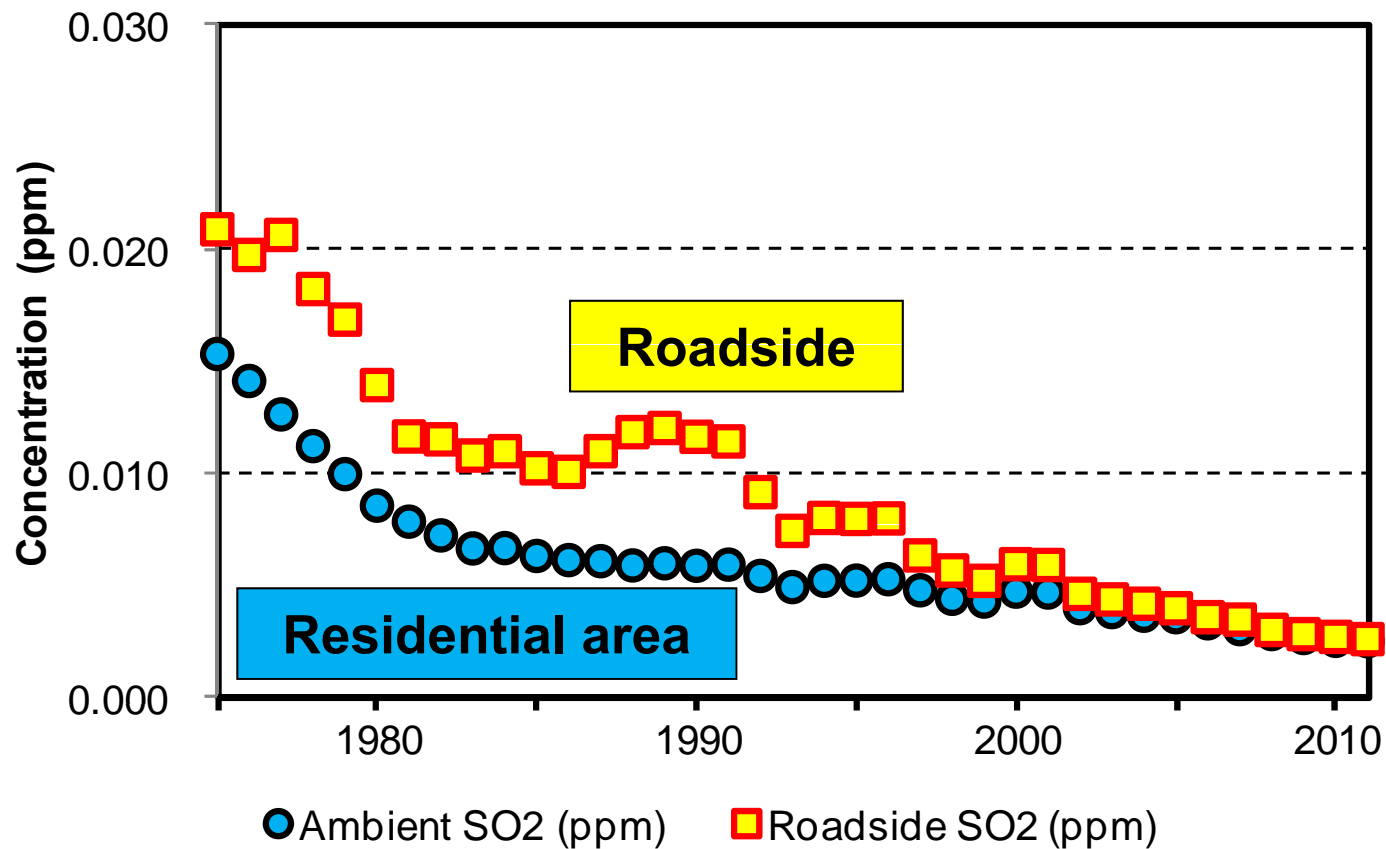
Annual average **SPM** concentrations (Suspended Particulate Matter)

SPM is similar to PM10



Annual average SO₂ concentrations (Sulfur Dioxide)

Unit Conversion of SO₂
0.01 ppm = 27 µg/m³



Annual average CO concentrations (Carbon monoxide)

Unit Conversion of CO
1 ppm = 1.2 mg/m³

