



*Further Challenge in  
Automobile and Fuel Technologies  
for Better Air Quality*

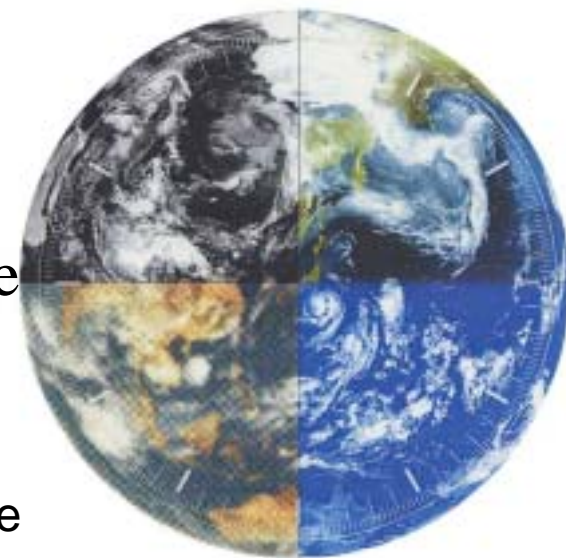
# **JCAP** : Its Outline and Outcome

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Chairman, JCAP Research Committee  
Professor, Kogakuin University

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SAE Fuel & Lubricants Meeting @ Toulouse



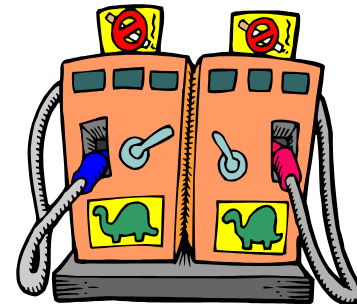
# What is JCAP?

## (Japan Clean Air Program)

- Collaborative study by automobile and oil industries *to find* the best combination of automobile and fuel technologies to improve the air quality of Japan and *to provide* the government with rational technical data for policy making
- Supported by Petroleum Energy Center, a subsidy of METI

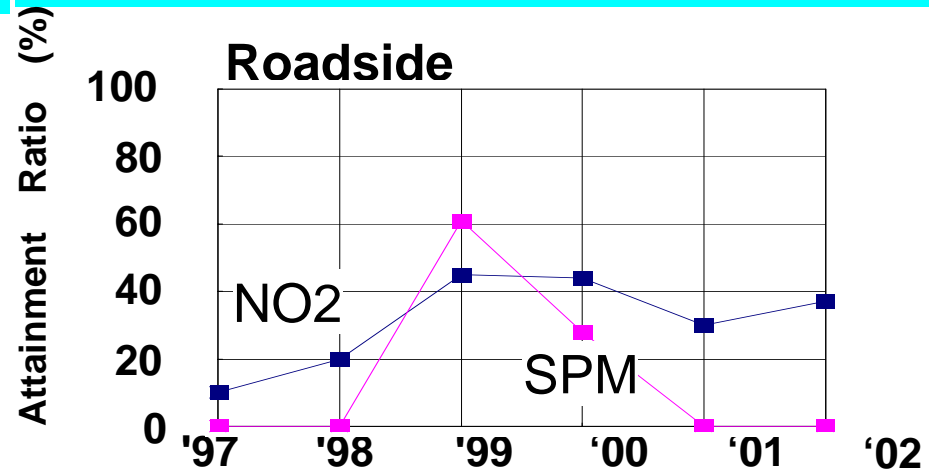
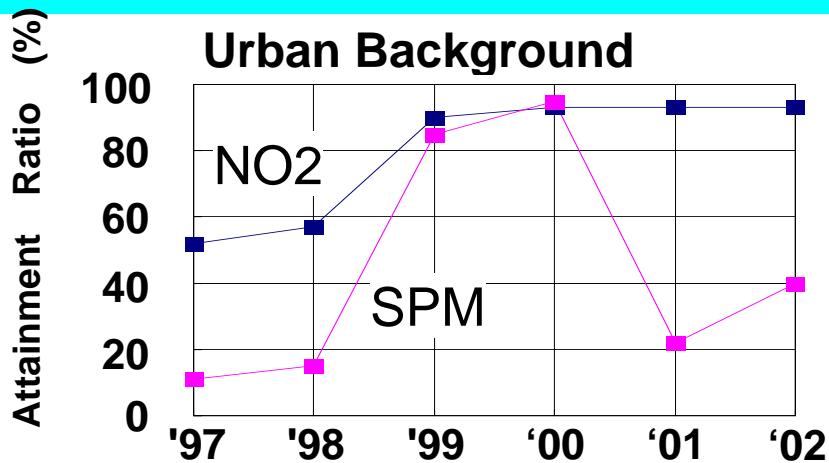
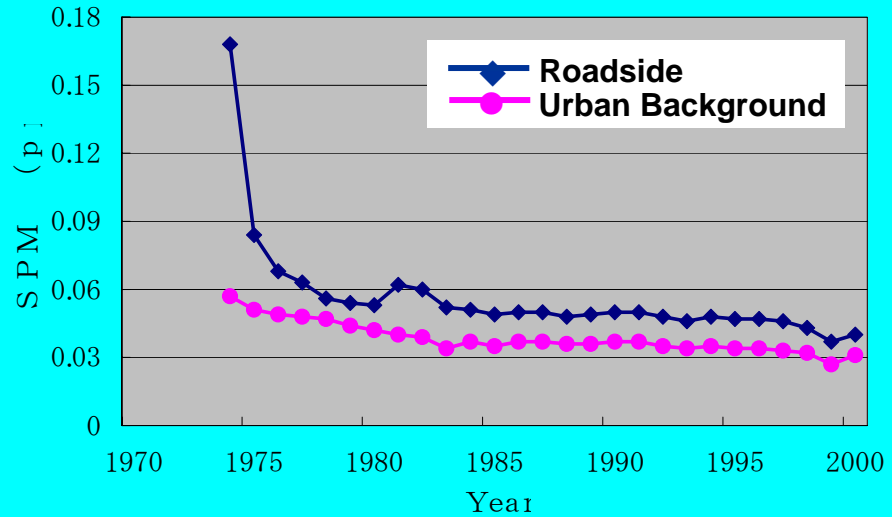
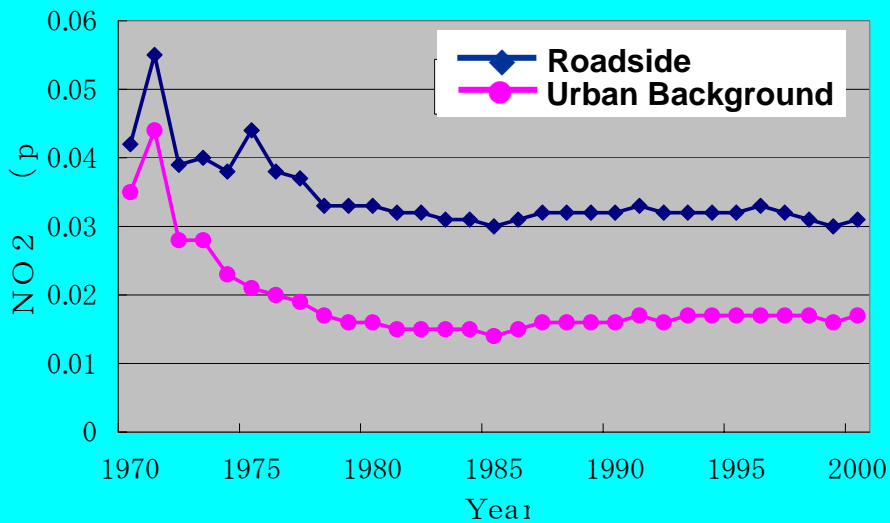
*METI: Ministry of Economy, Trade and Industry*

- JCAP I :1997 – 2001 (Budget: Approx. 5.4 billion yen, Numbers of staffs: over 100 members)
- JCAP II: 2002 – 2006 (Budget : Approx. 5.6 billion yen, Numbers of staffs: about 130 members)



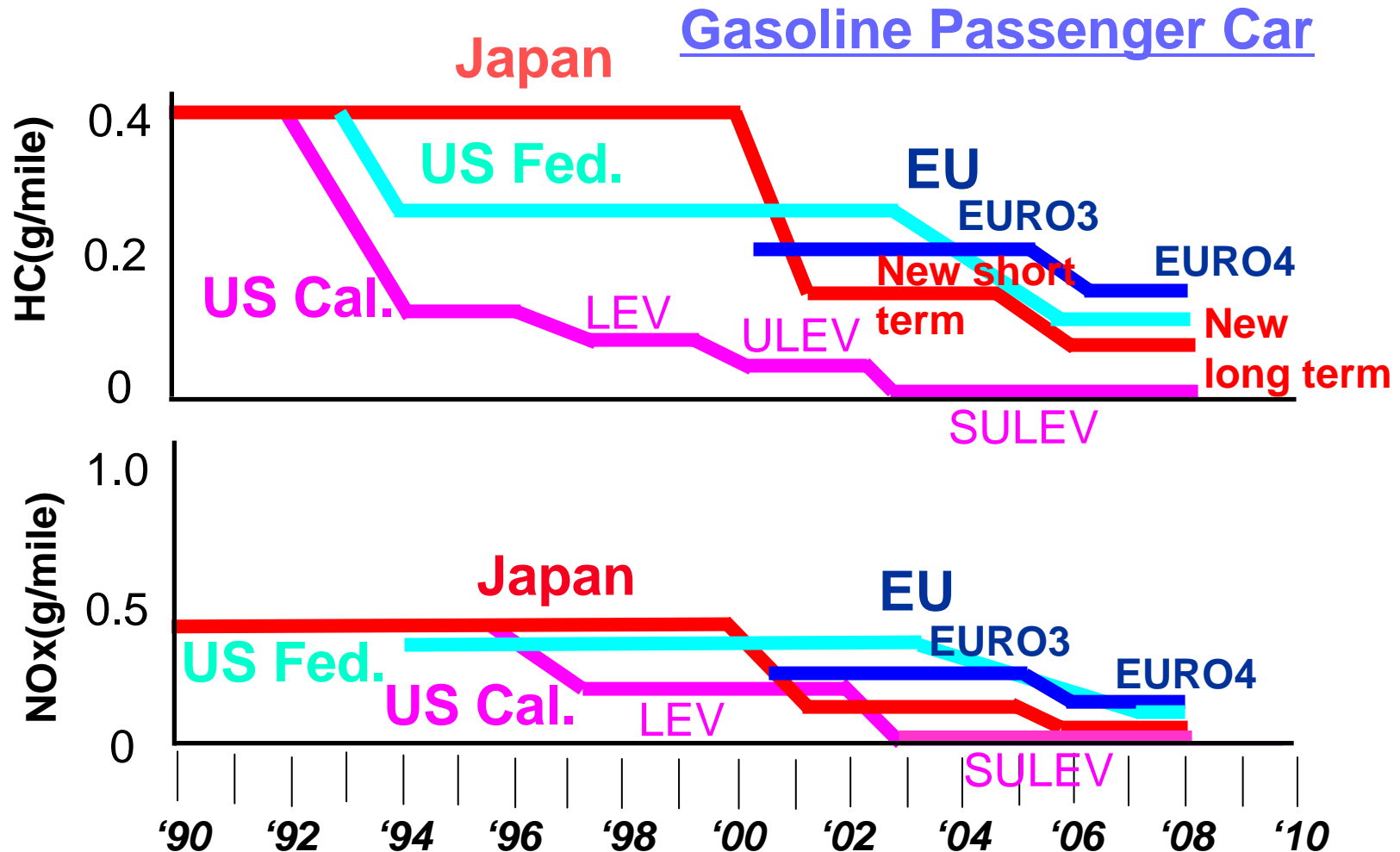
# Air Quality Improvement in Japan

Average  $\text{NO}_2$ /SPM concentrations decreased at first, but are stable in the last two decades, and the attainment of the environmental standards is low on the roadside.



# Japanese Regulations' Trend

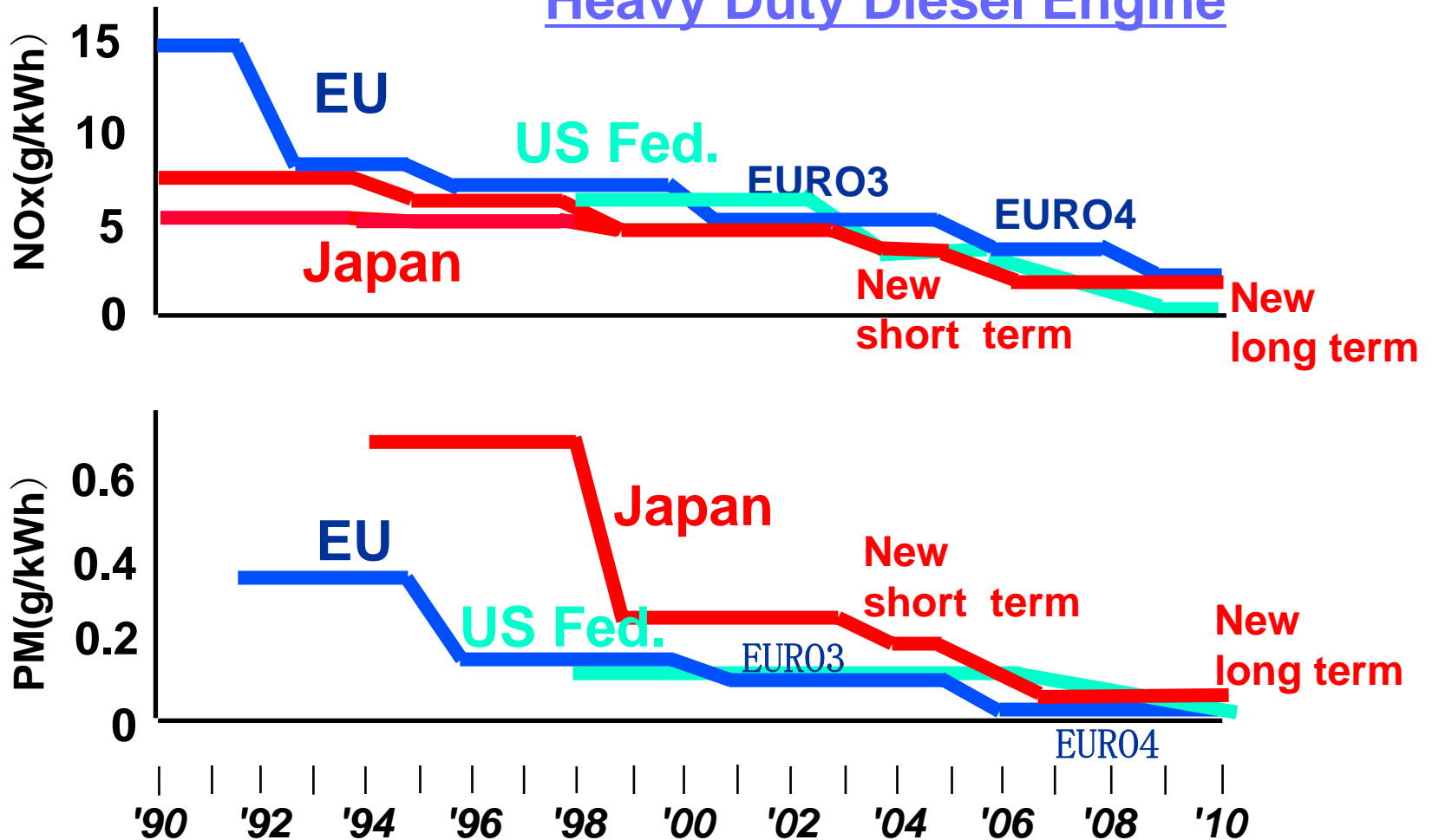
Becoming more and more stringent with international harmonization, and considering traffic conditions and climate of Japan



# Japanese Regulations' Trend

Making international harmonization in principle, and considering traffic conditions and climate of Japan

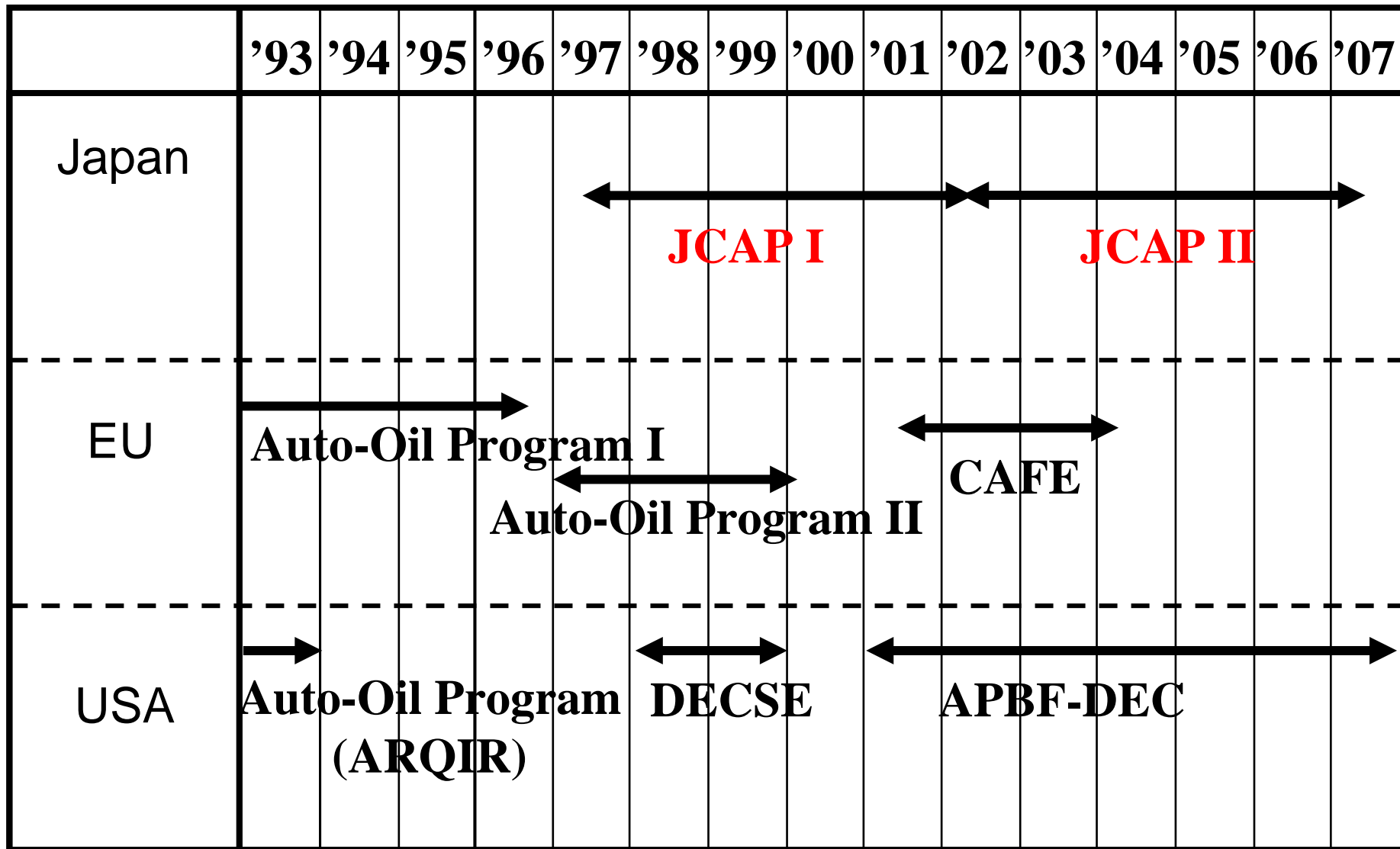
## Heavy Duty Diesel Engine



# Regulations of Sulfur Contents in Automobile Fuels

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>Gasoline</b>										
Japan	100ppmS				50ppmS		10ppmS			
EU	150ppmS				50ppmS				10ppmS	
USA	500ppmS				30ppmS					
<b>Diesel</b>										
Japan	500ppmS			50ppmS			10ppmS			
EU	350ppmS				50ppmS				10ppmS	
USA	500ppmS					15ppmS				

# Auto-Oil Program in USA, EU and Japan



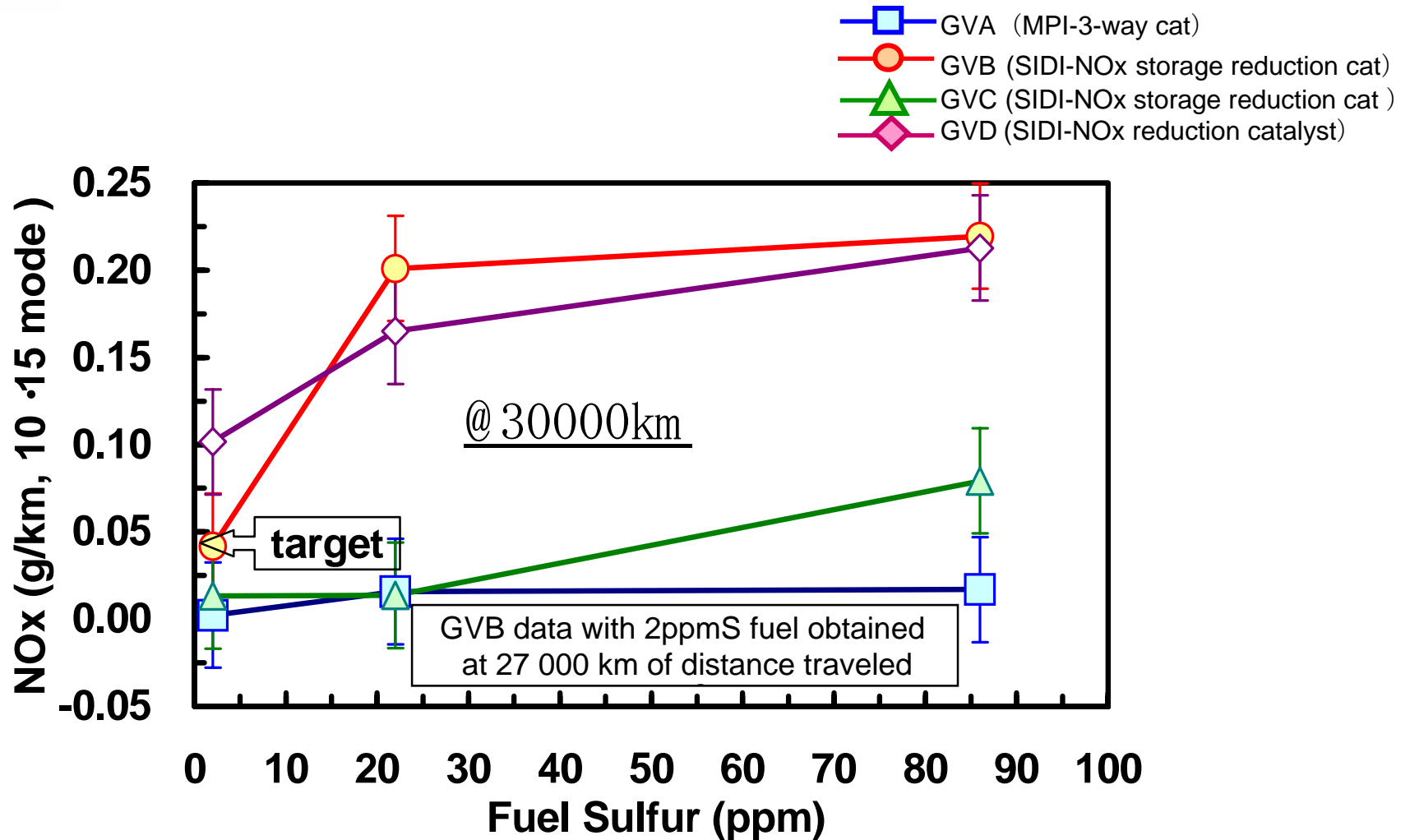
# Reflection in Environment and Energy Policies

1. Great effect of sulfur content in fuel on exhaust emissions  
⇒ **Reflected in fuel standard:**  
**50ppm S content; gasoline/diesel fuel from 2005**  
**10ppm S content gasoline/diesel from 2008/2007**
2. Great effect of Reid Vapor Pressure (RVP) of gasoline on evaporative emissions  
⇒ **Reflected in self-imposed control of gasoline RVP.**
3. Diesel Particulate Filter (DPF) retrofitted to in-use vehicles is not sufficient, under urban driving conditions.  
⇒ **Reflected in preparation of Tokyo Metropolitan Government's diesel vehicle emission regulations.**

These are reflected through Experts Committee on Motor Vehicle Exhaust Emission, Petroleum Products Quality Sub-committee of Advisory Committee for Natural Resources and Energy, Evaluation Committee of Diesel vehicle Emission Control Technologies.



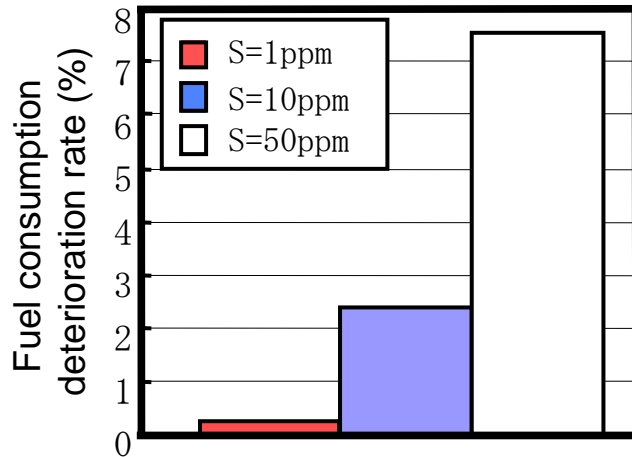
# Sulfur Effect on NOx Emissions



-Although no sulfur effect is shown in any test vehicles at 0 km, the effect is evident in SIDI vehicle at 30,000 km of distance traveled.

# Effect of Sulfur on Fuel Economy

## Gasoline Engine with NSR Catalyst



Effect on Fuel consumption 率

Approx. 5%  
Improvement  
(S = 50 -> 10 ppm)

(10-15 mode)

## Diesel Engine with NSR Catalyst

**S=50ppm**

Fuel consumption:  
6.62km/L

**S=10ppm**

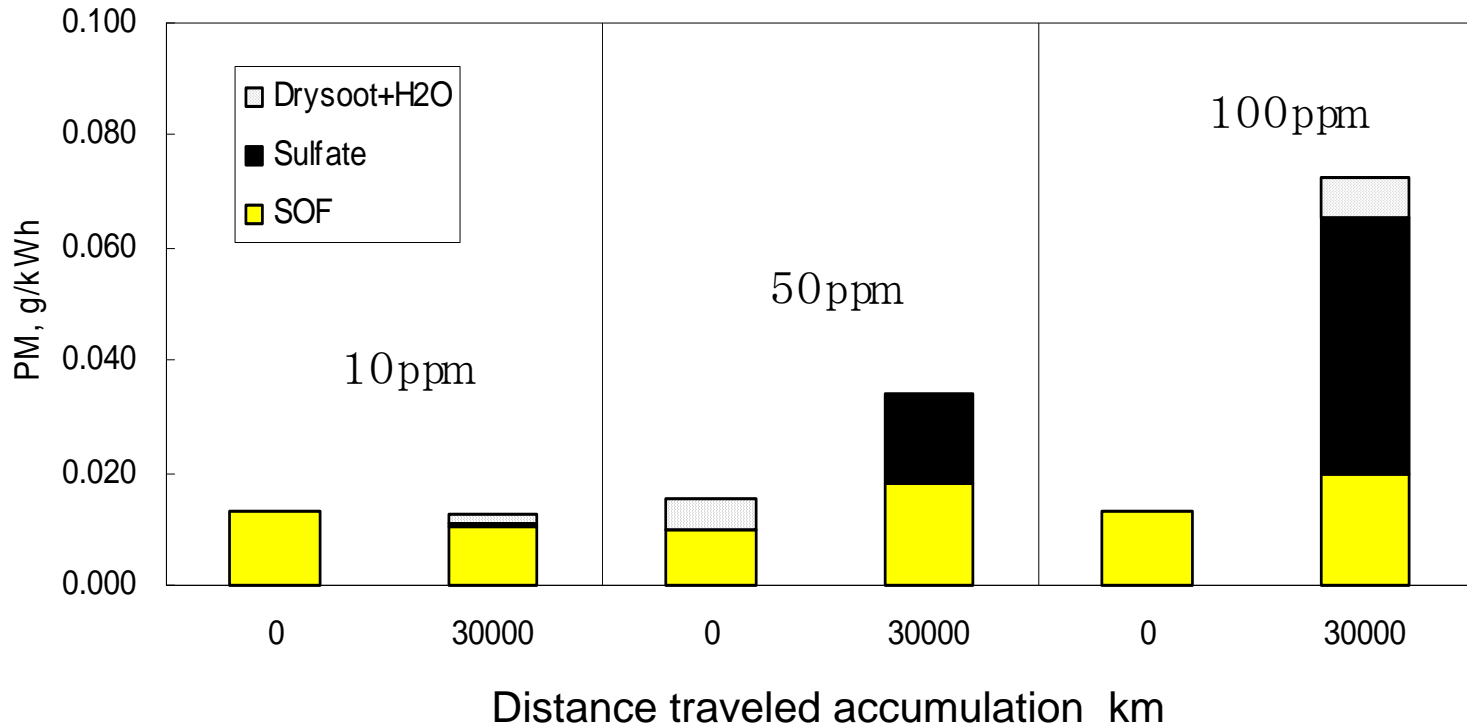
Fuel consumption:  
6.88km/L

**3.9%  
Improvement**

(Corrected 11 laps)

# Effect of Sulfur on DPF

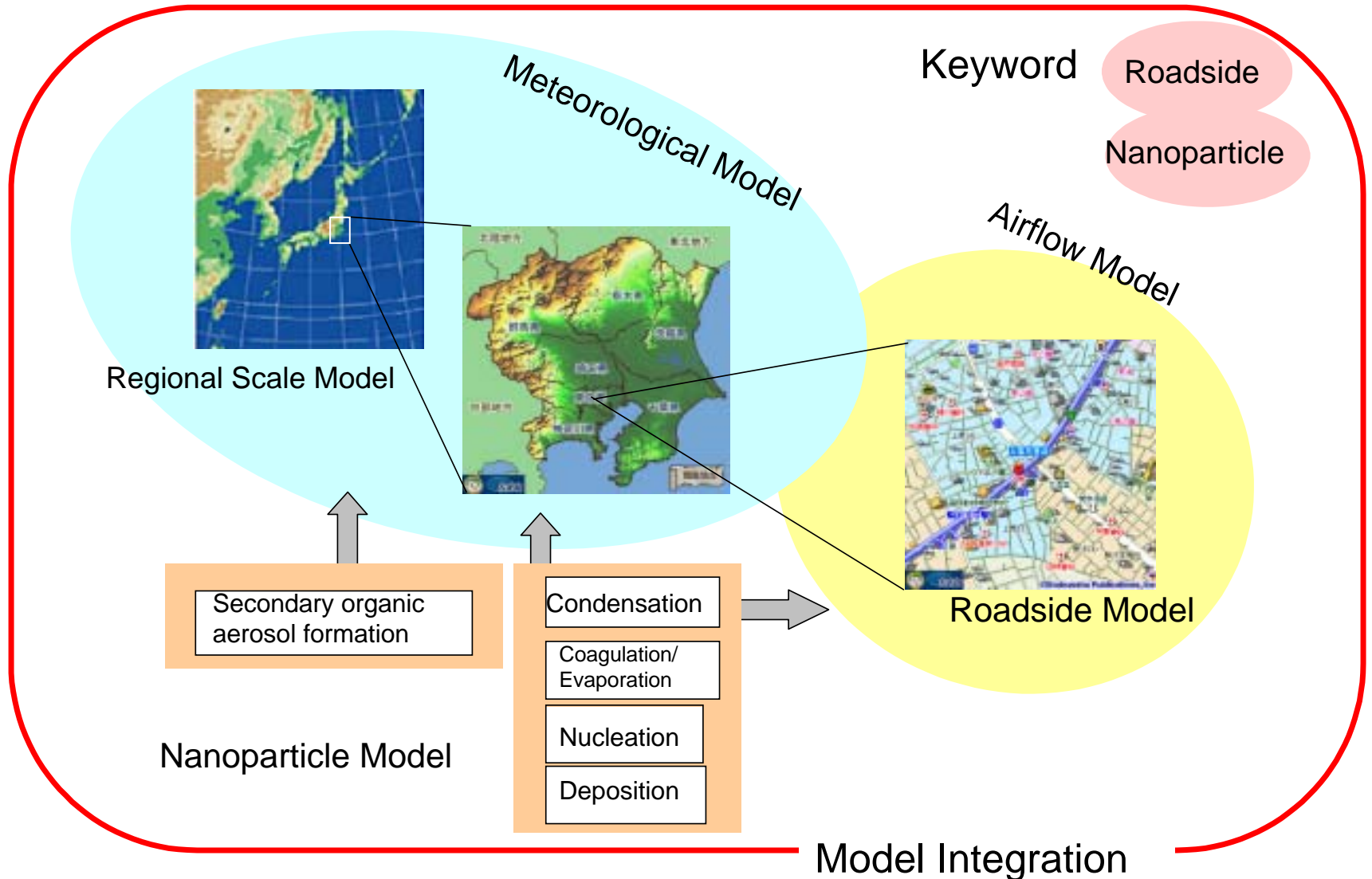
JARI Engine test cycle



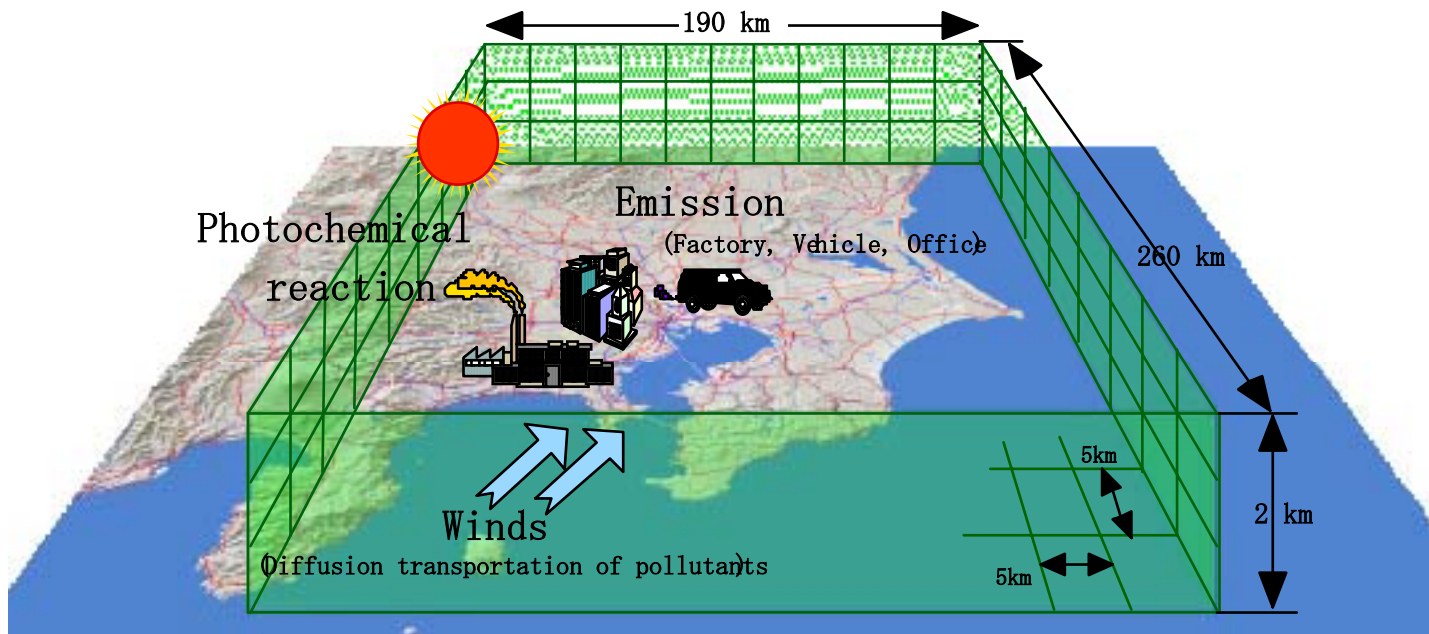
## Emissions from Diesel Vehicle

# JCAP Air Quality Model

## Establishment of Air Quality Model and Nanoparticle Model

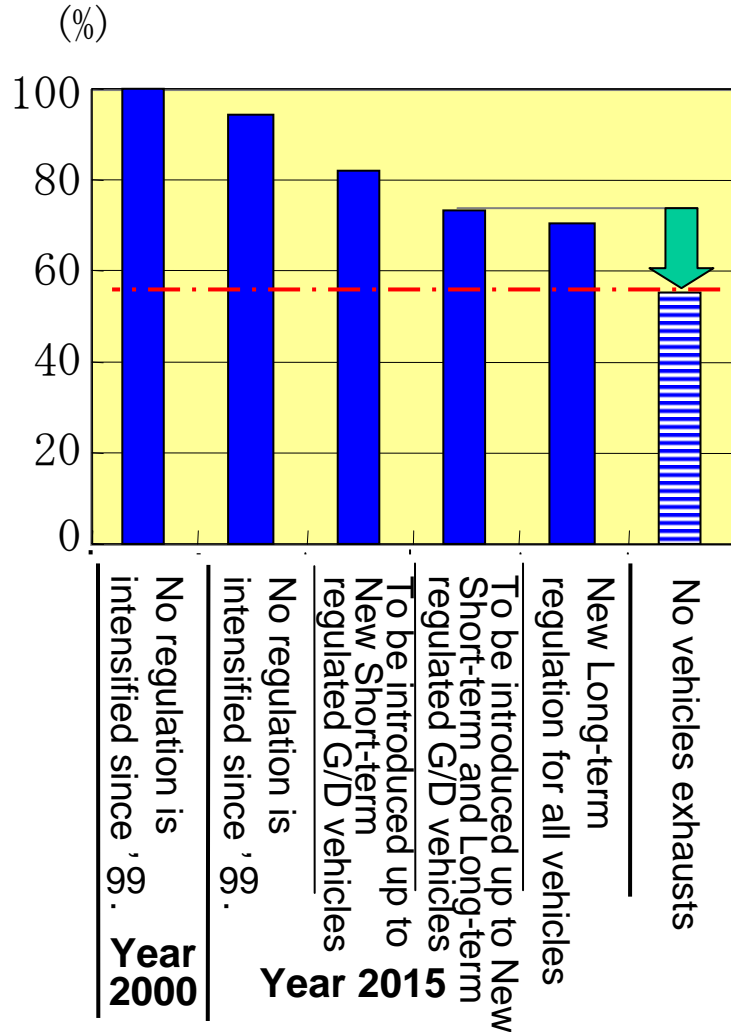


# JCAP Urban Air Quality Model



# Prediction of Air Quality by JCAP

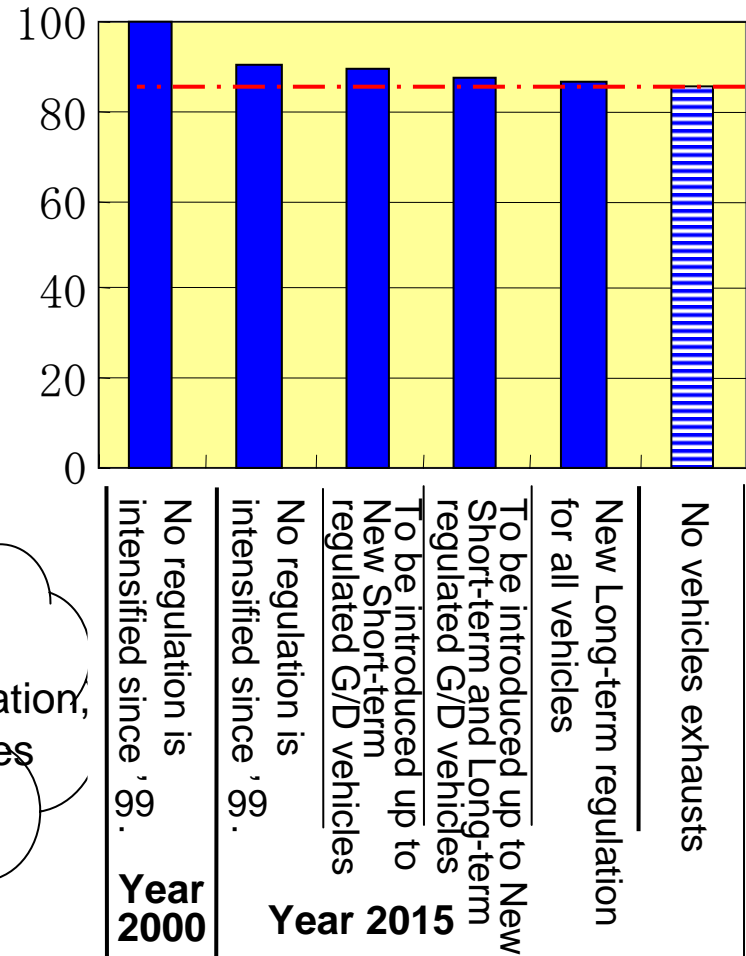
NO<sub>2</sub>



Contribution of Automobile Emissions

After 2005 Regulation, emission measures focus on NO<sub>2</sub>

SPM



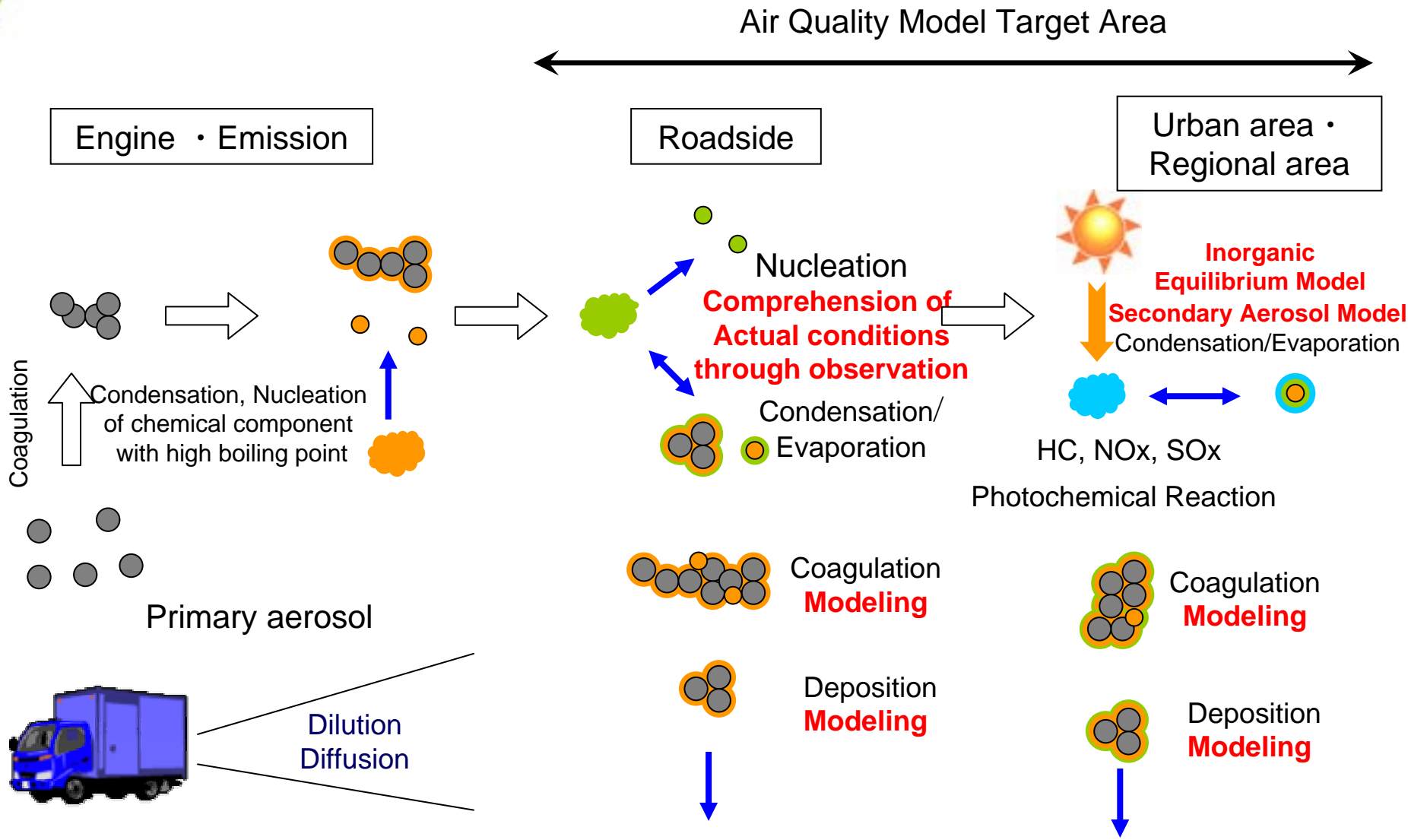
New Short-term Regulations: 2000/2 Regulations  
 New Long-term Regulations: 2005 Regulations

# Tasks of JCAP II

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1. Pursuing the future automobile and fuel technologies aimed at realizing **Zero Emissions** and improving fuel consumption, based on the latest technologies and overall energy efficiency.
2. Developing Air Quality models with high accuracy to predict real world.
3. Study of un-regulated emissions and nanoparticles from the vehicles.

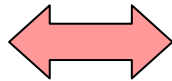
# Nanoparticle from Automobile (Image)



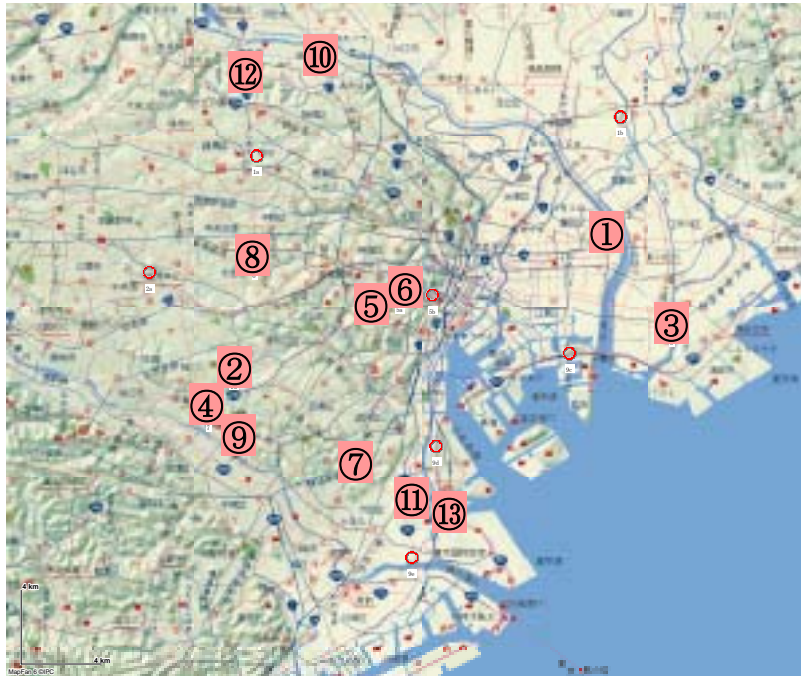


# Roadside Observation

Transportation conditions

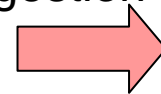


Particle size distribution in the air



Traffic volume  
HDV mix rate  
Average speed during traffic congestion

} Parameters



Selection of 13 spots in Tokyo Metropolis

Monitoring using SMPS:  
A run of 2.5 hours is carried out for once to 3 times per spot.

Video camera

Anemoscope/  
Anemometer

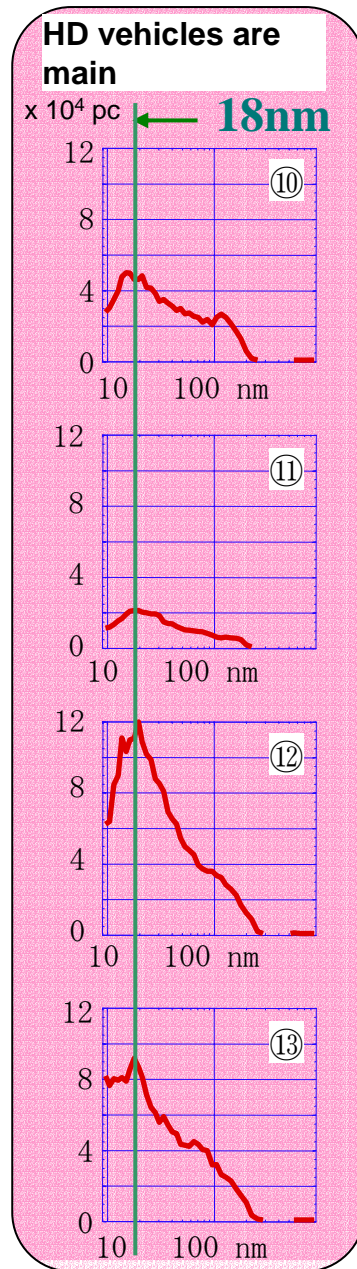
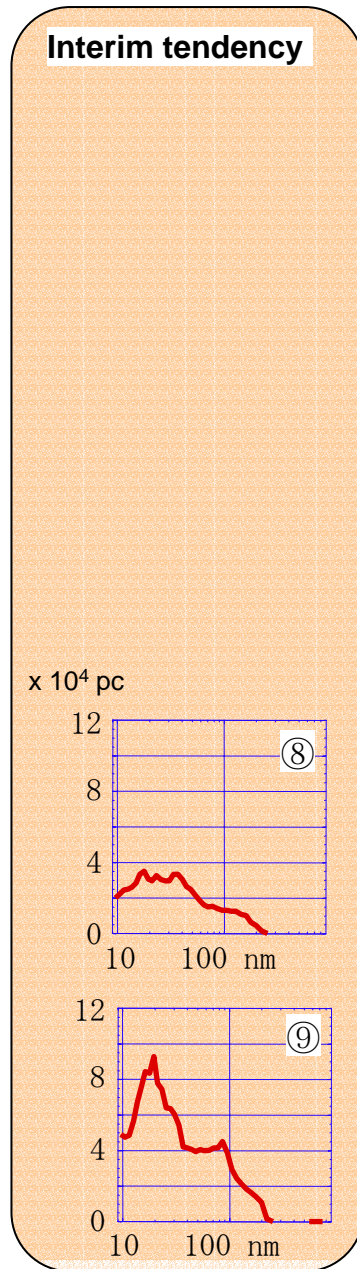
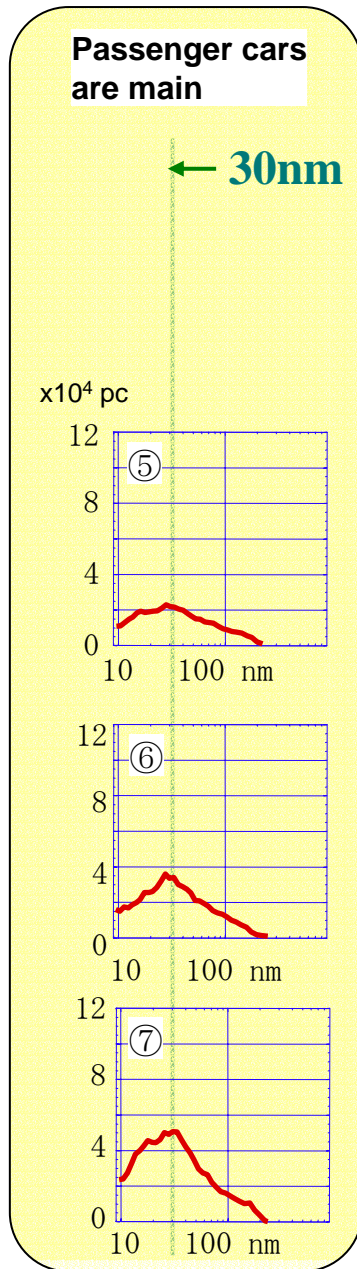
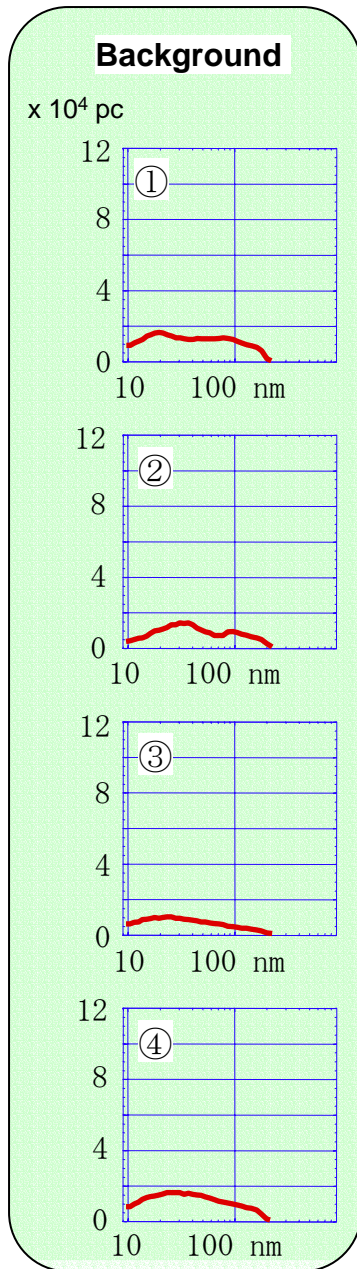
Opening for SMPS sampling

Temperature/  
Humidity sensor

Instrument truck



# Particle Size Distribution at Roadside



# Summary

## Outcome of JCAP I

1. Mutual understanding of Auto and Oil industries
2. Reliable data open to the public
3. Increased technical voice for making Air Quality policy
4. Comprehensive discussion on Air quality improvement, Energy (CO<sub>2</sub>), and Economical issues.

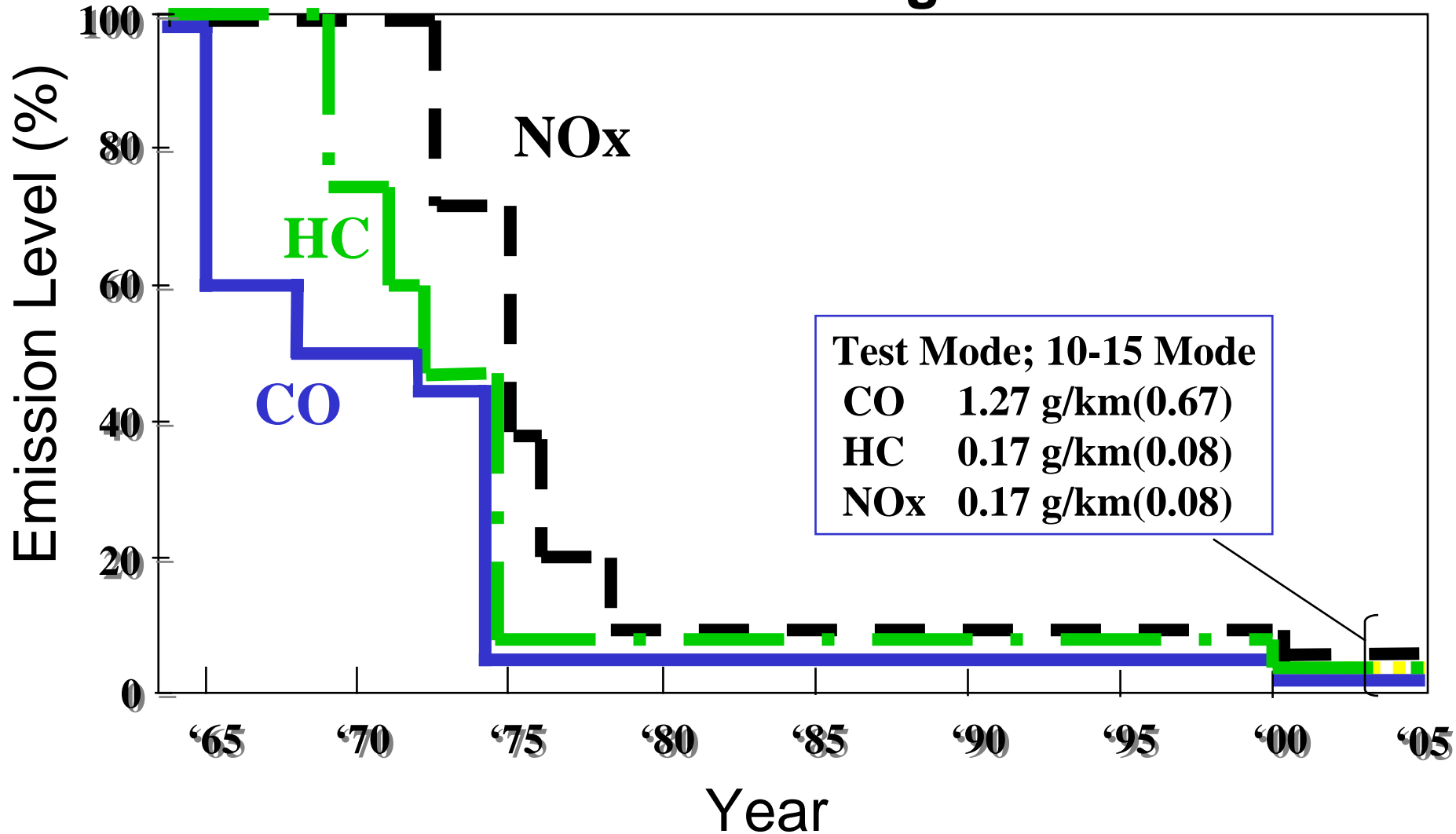
## Expectation for the future through JCAP II

1. Continuing cooperation of Auto and Oil industries
2. Reliable data (open to the public) using innovative technologies and Air Quality model
3. Evaluation of health effects in real world
4. Dialogues with citizens and industries other than Automobile and Oil industries.
5. To propose a socially optimal system using advanced Auto and Fuel technologies

# Appendix

# Regulations of Emissions in Japan

## Gasoline Passenger Car



# Regulations of Emissions in Japan

## Gasoline Passenger Car

