Overview and Future Prospect of Emission Regulations in Japan

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Background of Environment Problems caused by Automobiles

Environmental Problems Caused by Automobiles

What are the problems? What are the causes?

Convenience of Automobiles

Increase in Number of Vehicles
(in Japan 75 million/2000)

Increase in Global Environmental Load

Exhaust Gases

Noise, Vibration

Use of Motor Vehicles

Number of vehicles

3.4 million in fiscal 1961
75 million in fiscal 2000

passenger cars
About 0.44 million in fiscal 1961
About 42 million in fiscal 2000

Ratio of transportation volume by motor vehicles

Freight (ton×km)	Passenger (number×km)
26% in fiscal 1965	31% in fiscal 1965
47% in fiscal 1985	57% in fiscal 1985
54% in fiscal 2000	67% in fiscal 2000

Status of Air Pollution and Contribution of Automobiles in Japan

Environmental Problems by Automotive Exhaust

Caused by Combustion of Fossil Fuel

- Gasoline Engines
- Diesel Engines

Components for Emission Regulation

Carbon monoxide (CO)
Hydrocarbons (HC)
Nitrogen oxides (NOx)
Particulate matter・・・Diesel?

Other Harmful Components

Benzene
Formaldehydes
Benzo(a)pyrene
etc.

Greenhouse Effect Gases

Carbon dioxide (CO2)
Nitrous oxide (N2O)
Methane (CH4)

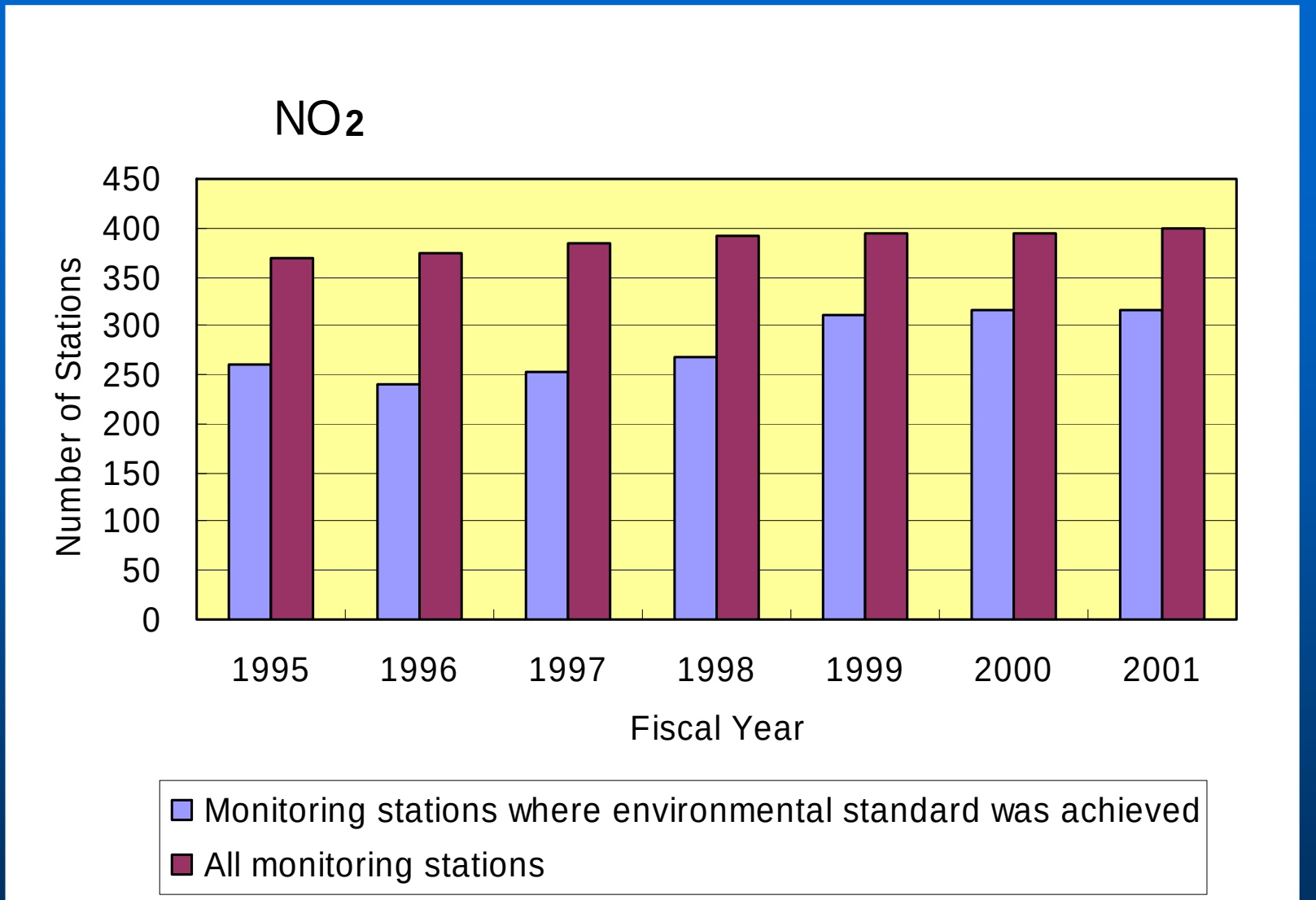
Present status of atmospheric environment caused by automobiles in Japan

(1). Attaining rate of environmental standard for NO2 and suspended particulate matter (SPM) has not improved and remained very low level in big cities such as Tokyo, Osaka etc.

(2). Increase in traffic volume, especially diesel vehicle, is considered to be the main cause.

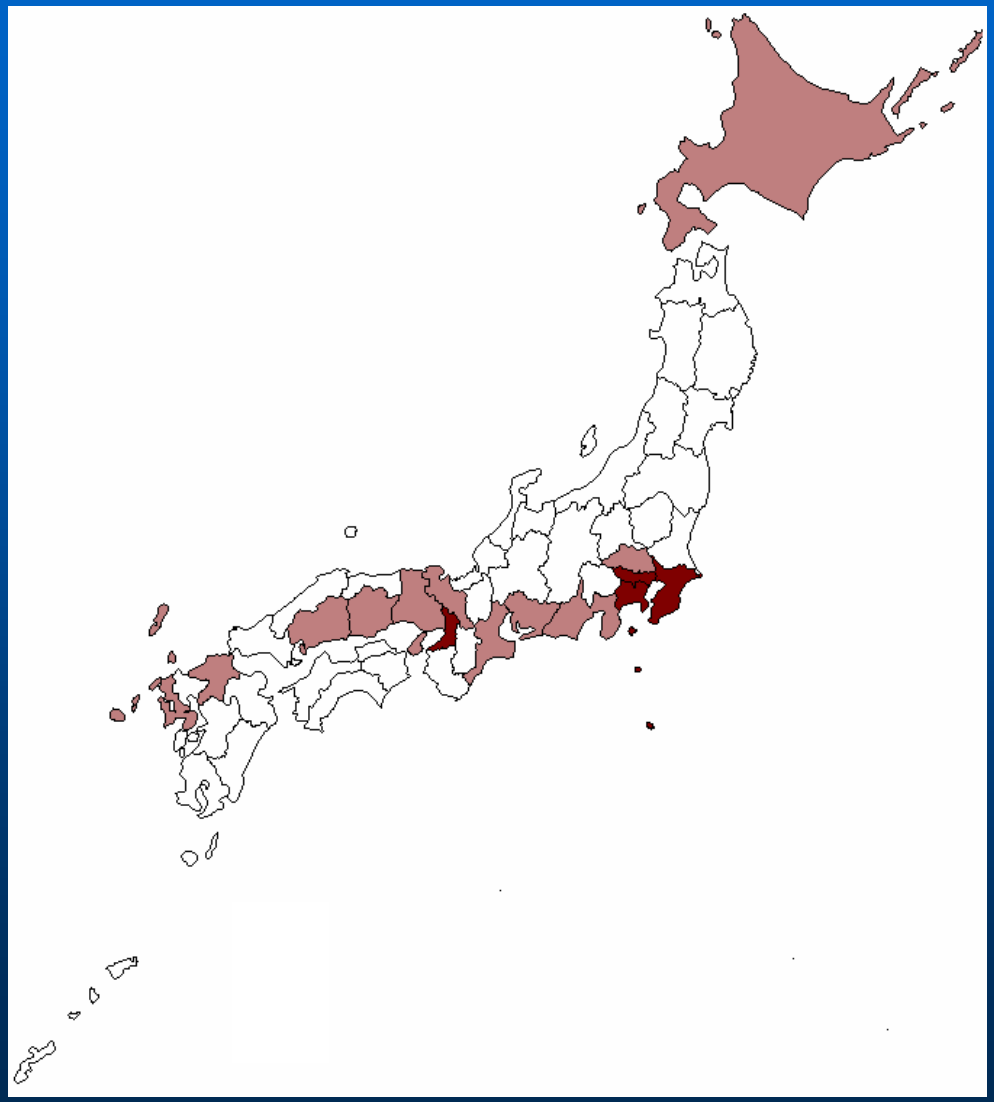
- 50% of NOx discharged in the atmosphere
- 30 to 40% of particulate (PM) discharged in the atmosphere are from automobiles.

(3). Rate of the number of diesel vehicle: 18% in total vehicle in Japan. However 75% of NOx and most of PM from automobiles are caused by diesel vehicles.

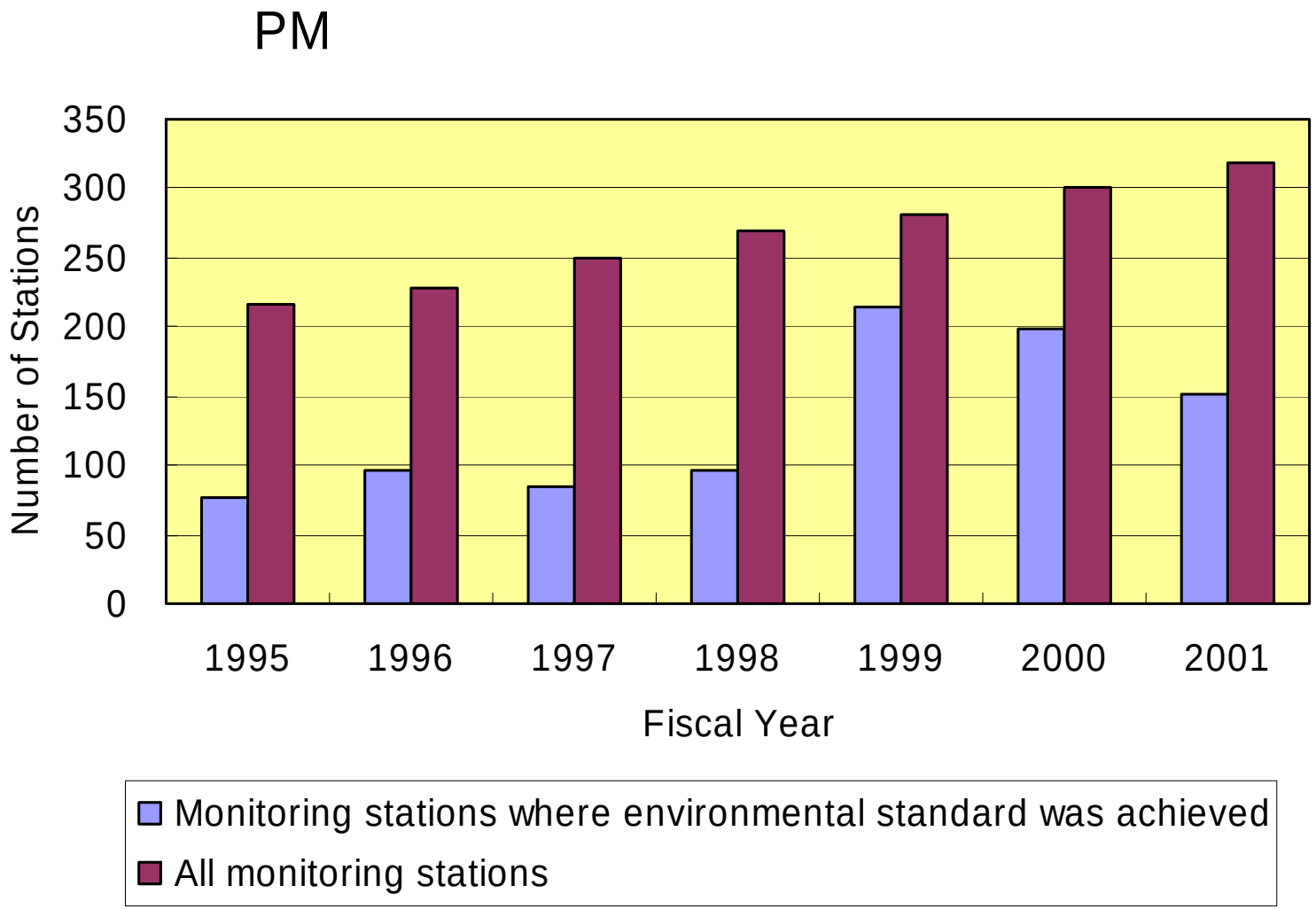


Transition of environmental standards attainment level for NO2 (Based on measurement taken at roadside monitoring stations)

Un-attainment state of Environmental Quality Standards for NO_2 FY2000

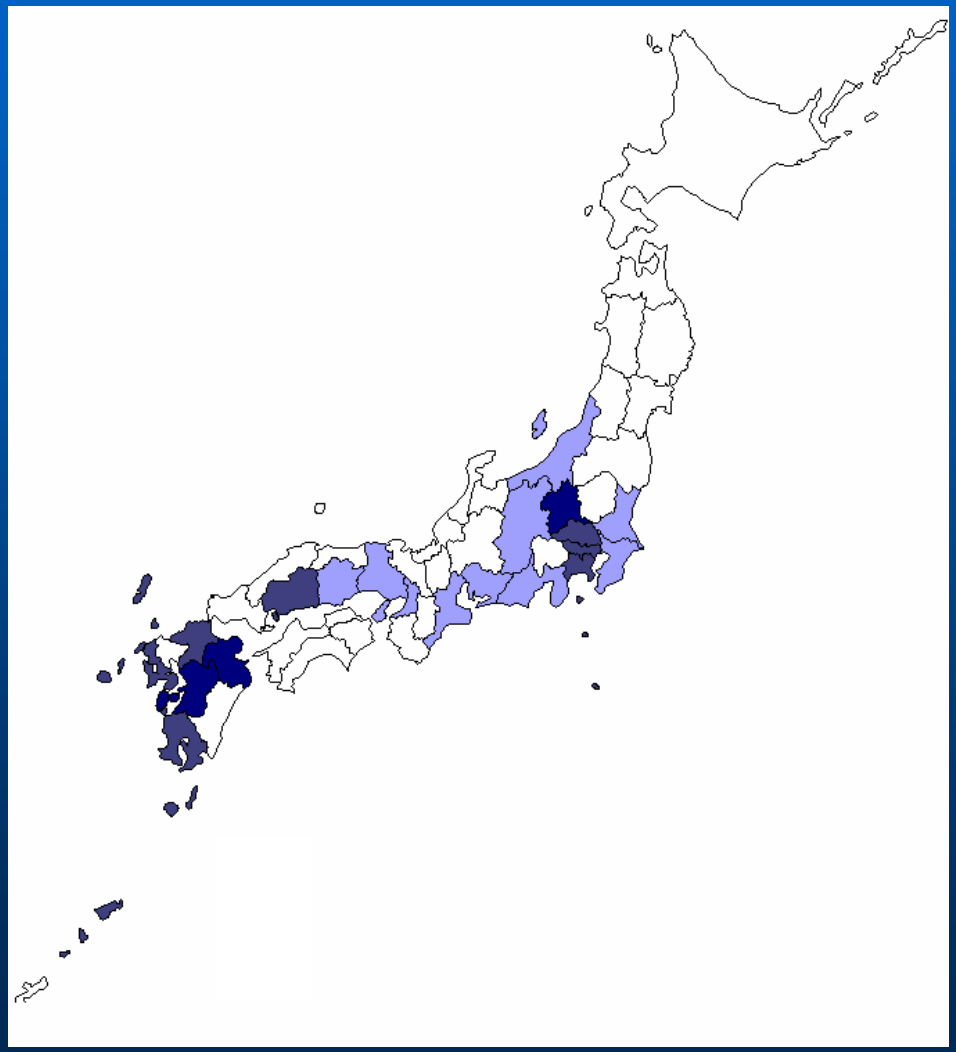


- Standard not attained at general and roadside stations (4-statons)
- Standard not attained at roadside stations (11-statons)
- Standard attained at all stations (32-statons)



Transition of environmental standards attainment level for PM (Based on measurement taken at roadside monitoring stations)

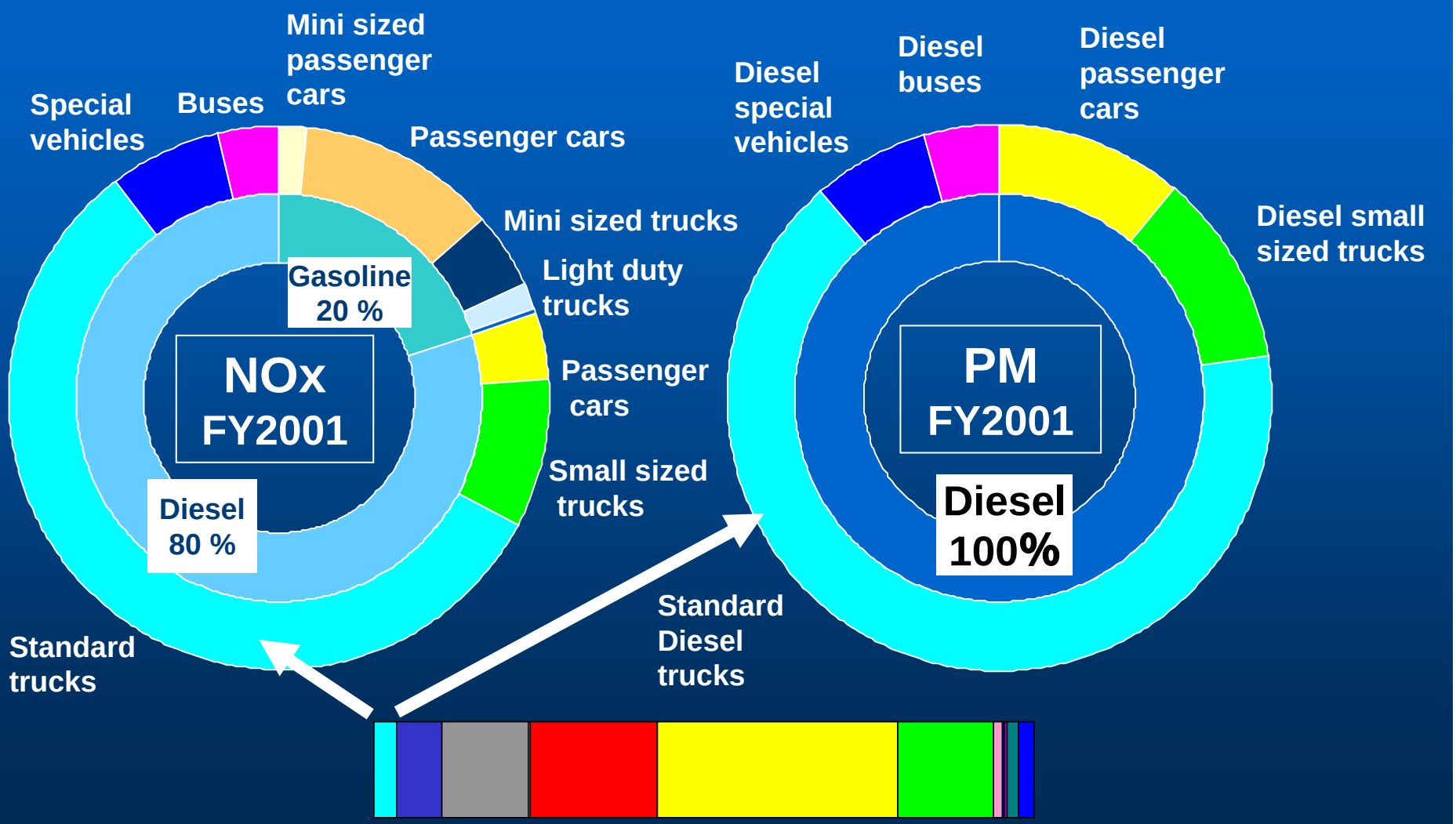
Attainment rate of Environmental Quality Standards for SPM FY2000 (Roadside monitoring stations)



- 0 - under 30 % (3-statons)
- 30 - under 60 % (7-statons)
- 60 - under 90 % (10-statons)
- 100 % (27-statons)

Rate of emission by vehicle classification

Note; PM of the gasoline vehicles are not measured in Japan



Standard trucks / Diesel ; 3.3 %

Automotive Emission Regulations in Japan

MOTOR VEHICLE EXHAUST EMISSION REGULATIONS

- The Air Pollution Control Law (Environment Agency)

  permissible limits on the amounts of motor vehicle exhaust emissions

- The Road Vehicle Act
  (Ministry of Land, Infrastructure and Transport)

  matters necessary for vehicle exhaust emission regulations by means of the safety regulations for road vehicles to ensure that these permissible limits are met

History of Gasoline and LPG Vehicle Emission Regulations in Japan

Sept, 1967:Four mode CO regulations under the Safety Regulations of the Road Vehicle Act.

July, 1970: Council for Transport Technology 1970 with suggested 1973 regulations

Oct,1972: Central Council for Environmental Pollution Control submits 1972 report with suggested 1975 and 1976 regulations (Japanese version of the “Muskie Act”)

Dec,1974: Central Council for Environmental Pollution Control submits 1974 report with suggested two year postponement of 1976 regulations for passenger cars to 1978

Oct,1976: Final report of the Investigation Committee for Motor Vehicle Nitrogen Oxides Reduction Technology:
(Assessment of the feasibility of implementing the 1978 regulations)

History of Gasoline and LPG Vehicle Emission Regulations in Japan (Cont'd)

Dec,1977: Central Council for Environmental Pollution Control submits 1977 report proposing two-stage implementation of stronger truck and bus regulations:

①First stage (1979 regulations)

②Second stage (1981,1982 regulations)

July, 1986: Central Council for Environmental Pollution Control submits 1986 interim report with suggested 1988,1989 and 1990 truck and bus regulations

Dec, 1989: Central Council for Environmental Pollution Control submits 1989 report proposing two-stage implementation of stronger regulations for medium- and heavy-duty trucks and buses:

①Short-term targets (1992 regulations)

②Long-term targets

(within 10 years: 1994 and 1995 regulations)

Recommendations for 10/15-mode and 13-mode control regulations

History of Diesel Vehicle Emission Regulations in Japan

Dec,1977: Central Council for Environmental Pollution Control submits 1977 report proposing two-stage implementation of stronger regulations for all vehicle categories:

①First stage (1979 regulations)

②Second stage (1982,1983,1986,1987,1990 and 1992 regulations)

July, 1986: Central Council for Environmental Pollution Control submits 1986 interim report with suggested 1988,1989 and 1990 regulations

Dec, 1989: Central Council for Environmental Pollution Control submits 1989 report proposing two-stage implementation of stronger regulations for all vehicle categories:

①Short-term targets (1993 and 1994 regulations)

②Long-term targets

(within 10 years: 1997,1998 and 1999 regulations)

Recommendations for 10/15-mode and 13-mode control regulations

Recommendation to introduce PM regulations

Policy for Motor Vehicle Exhaust Emission Reduction Measures

Member of Experts Committee on Motor Vehicle Exhaust Emissions, and the Working Committee / Air Quality committee of the Central Environment Council

Michikata Kono （ Professor, Tokyo University ） Chairman
Kazuhiko Sakamoto (Professor, Saitama University)
Yasuhiro Daisho（Professor, Waseda University）
Takashi Ibusuki (Manager, National Institute of Advanced Industrial Science and Technology)
Masakazu Iwamoto (Professor, Tokyo Institute of Technology)
Matsuo Odaka（Executive Director, NTSEL）
Takeshi Saitou (Manager, National Research Institute of Police Science)
Masahiro Shioji（Professor, Kyoto University）
Hiroyasu Nagae (Professor Emeritus, Nihon University)
Yasuhiro Fukuma (Japan Automotive Research Institute)
Hidetsuru Matsushita (Professor Emeritus, Shizuoka University)
Makoto Misonou (Professor, Kougakuin University)

"Future Policy for Motor Vehicle Exhaust Emission Reduction" (report by the Central Environment Council)

Gasoline and LPG Vehicles

- Oct,1996: interim report on the reduction of exhaust emission from two-wheeled vehicles.

- Nov,1997: submitted second report proposing two-stage implementations of stronger regulations for gasoline and LPG fueled vehicles of all categories

  ① New short-term targets
  (2000,2001 and 2002 regulations)

  2000 passenger car regulations were set by strengthening those of 1978

  ② New long-term target (deadline around 2005)

“Future Policy for Motor Vehicle Exhaust Emission Reduction” (report by the Central Environment Council)

Diesel Vehicles

- Dec,1998: Submitted third (1998) report proposing two-stage implementation of stronger regulations for all vehicle categories:

  ① New short-term targets
  (2002,2003 and 2004 regulations)
  ② New long-term targets (deadline around 2007)

Reduction of exhaust emissions from diesel powered vehicles

Diesel emission regulations are to be tightened in two steps

1) New short-term target.
For passenger cars, trucks, and buses, during 2002 to 2004, all exhaust emission components subject to regulations are to be reduced by about **30% to 70%** from the current regulation level.

2) New long-term target.
For all categories of vehicles, emission control technology is to be developed with the aim of reducing exhaust emissions to **about half** the new short-term target values by 2005.
Regarding the diesel fuel quality required to achieve the new long-term target values, the required fuel sulfer content will be reduced to 50 ppm by the end of fiscal 2004.(4th recommendation (November 2000))

The fourth recommendation

Nov,2000: submitted fourth (2000) report proposing that the diesel new long-term targets should be achieved earlier (in 2005)

① Recommends reduction of the sulfur content of diesel fuel from 500 to 50ppm

② Recommends faster achievement of the special motor vehicles regulations (by 2003)

Current Exhaust Emission Regulation in Japan

Gasoline passenger vehicle

Category			Test Mode	Gas component	Current regulation (average)		Note
					Fiscal year	Value (g/km)	
Gasoline & LPG	Passenger	4cycle & 2cycle	10-15 mode	CO	2000	0.67	Currently no production of 2cycle vehicle
				HC	2000	0.08	
				NOx	2000	0.08	
			11mode (g/test)	CO	2000	19	
				HC	2000	2.2	
				NOx	2000	1.4	

Diesel passenger vehicle

Category		Test Mode	Gas Component		Current regulation		3rd.Recomendation	
					Fiscal year	Value (g/km)	Fiscal year	Value (g/km)
Diesel Vehicle	Passenger car	10-15 mode	CO		1986	2.1	2002	0.63
			HC		1986	0.4	2002	0.12
			NOx	Small	1997	0.4	2002	0.28
				Medium	1998	0.4	2002	0.3
			PM	Small	1997	0.08	2002	0.052
				Medium	1998	0.08	2002	0.056

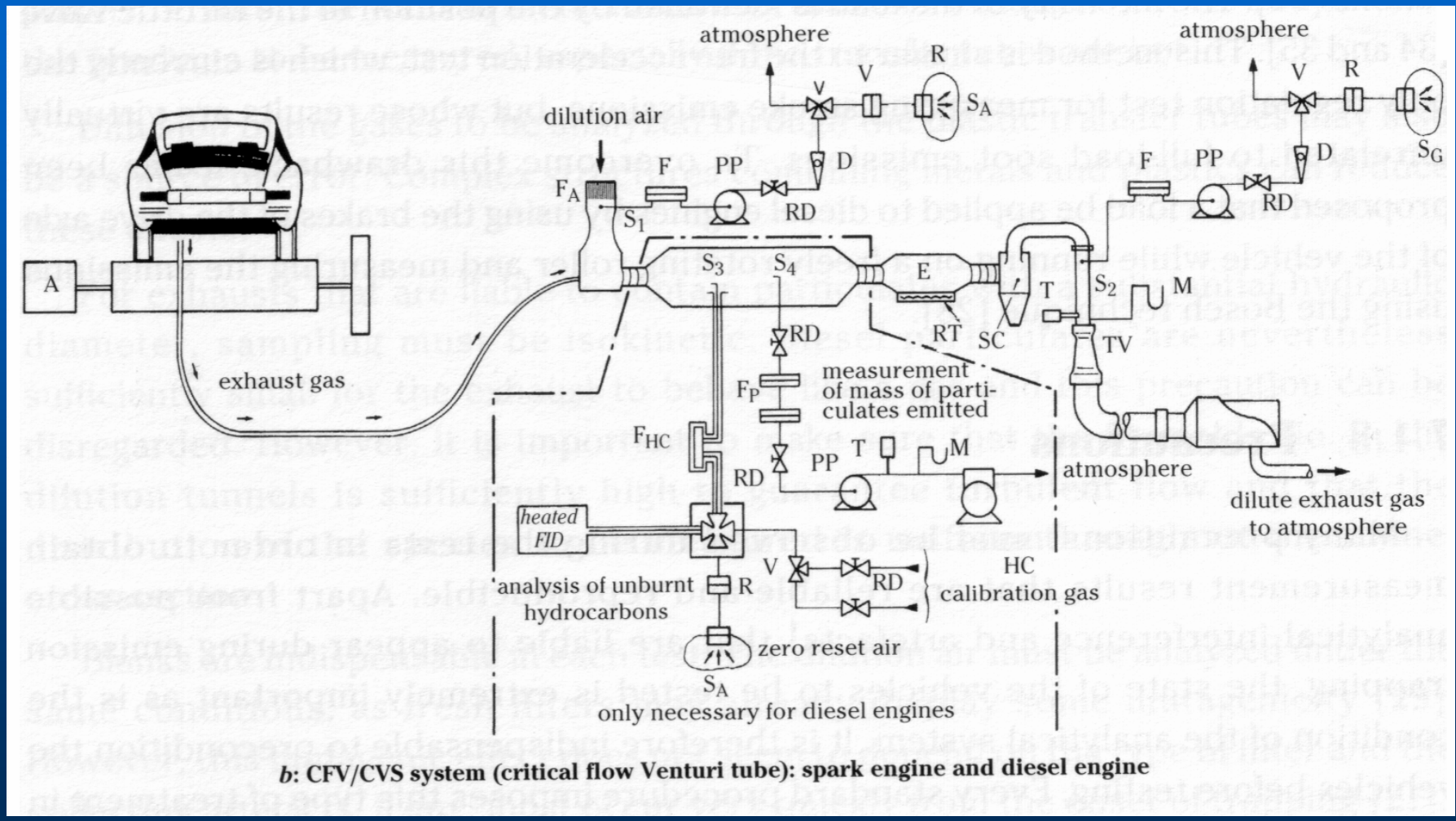
The fifth recommendation

1. New Long Term Target for gasoline vehicles
2. New Long Term Target for diesel vehicles
3. Change of exhaust emission test methods
4. Reduction of sulfur content in gasoline fuel
5. Future policy making for automotive exhaust emission reduction measure

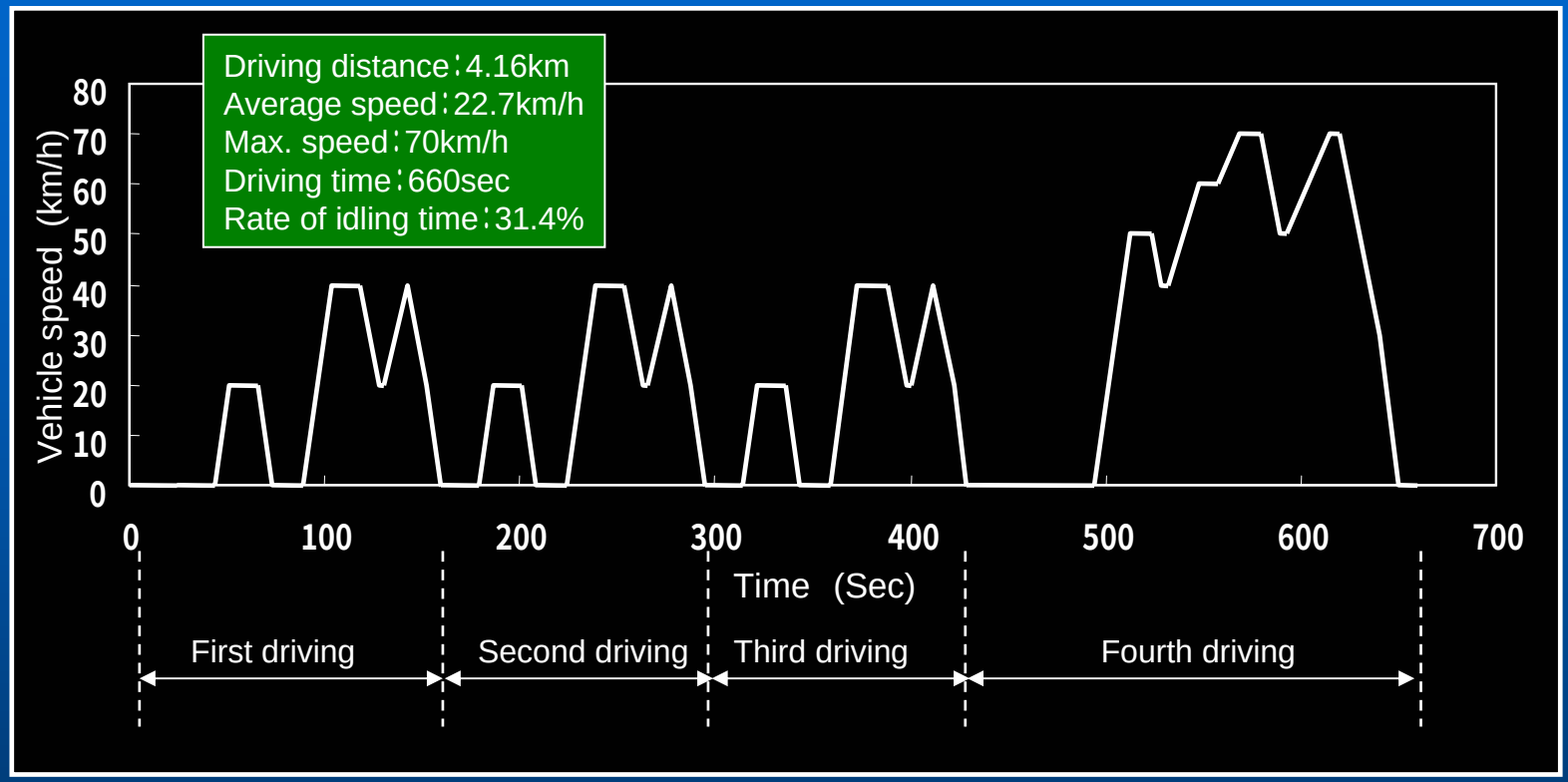
New Long-term Target Values for Gasoline-powered Vehicles

		NOx	NMHC	CO	Achievement Timing
Passenger car, Mini-sized passenger car		0.05	0.05	1.15	2005
Mini-sized truck		0.05	0.05	4.02	2007
Truck, bus	Light-duty (Less than 1.7tons in GVW)	0.05	0.05	1.15	2005
	Medium-duty (over 1.7tons and lessthan 3.5tons in GVW)	0.07	0.05	2.55	2005
	Heavy-duty (Over 3.5tons in GVW)	0.7	0.23	16.0	2005

Notes: 1) Unit of target values: g/kWh (heavy-duty trucks & buses), g/km (all others).
2) GVW: Gross Vehicle Weight. NMHC: Non-methane Hydrocarbon

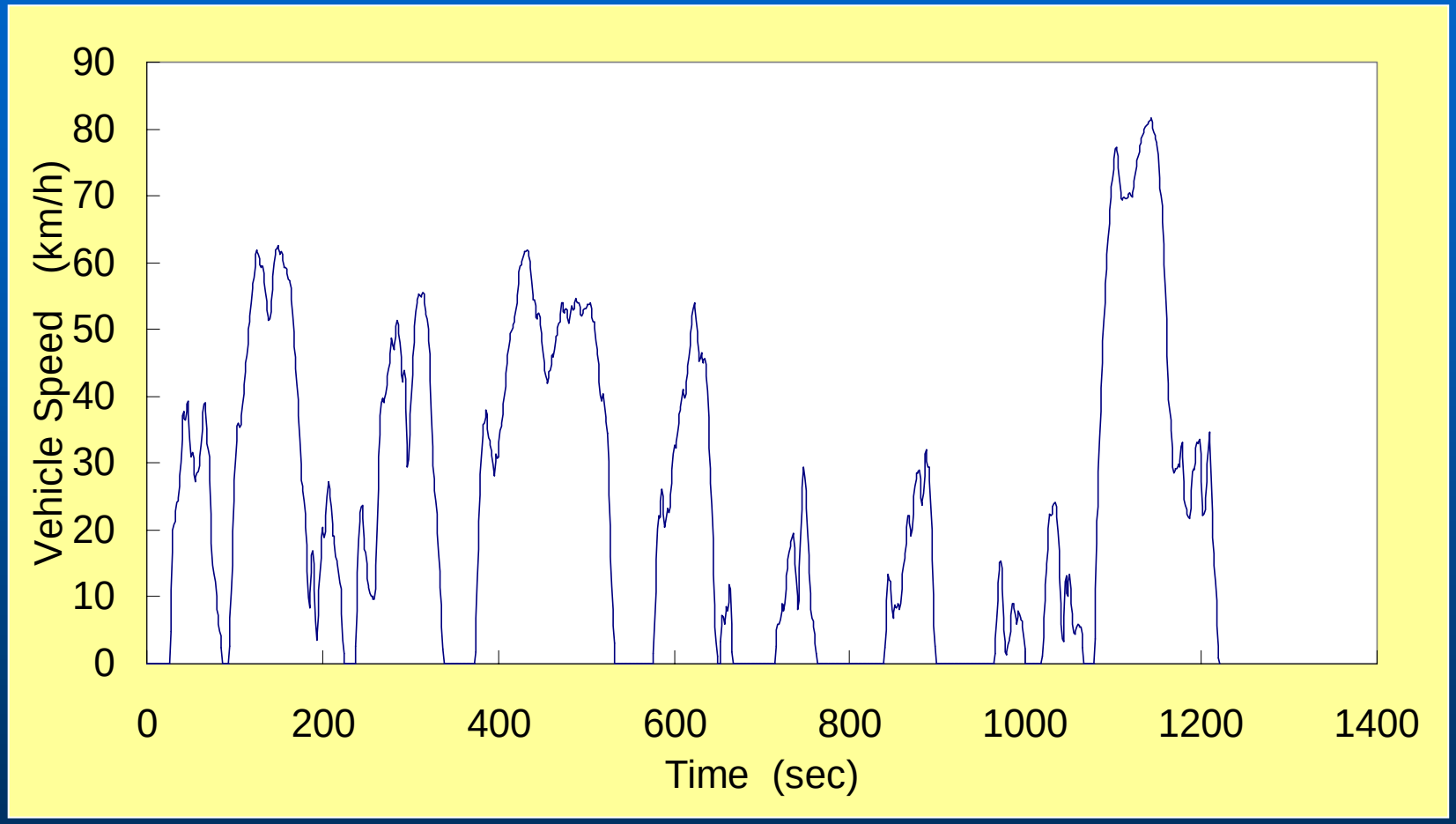


***b*: CFV/CVS system (critical flow Venturi tube): spark engine and diesel engine**



10-15 mode driving pattern for official exhaust emission test in Japan
(Transient mode, Hot start)

New test mode for vehicle with GVW < 3500kg



Current Exhaust Emission Regulation in Japan (diesel truck, bus)

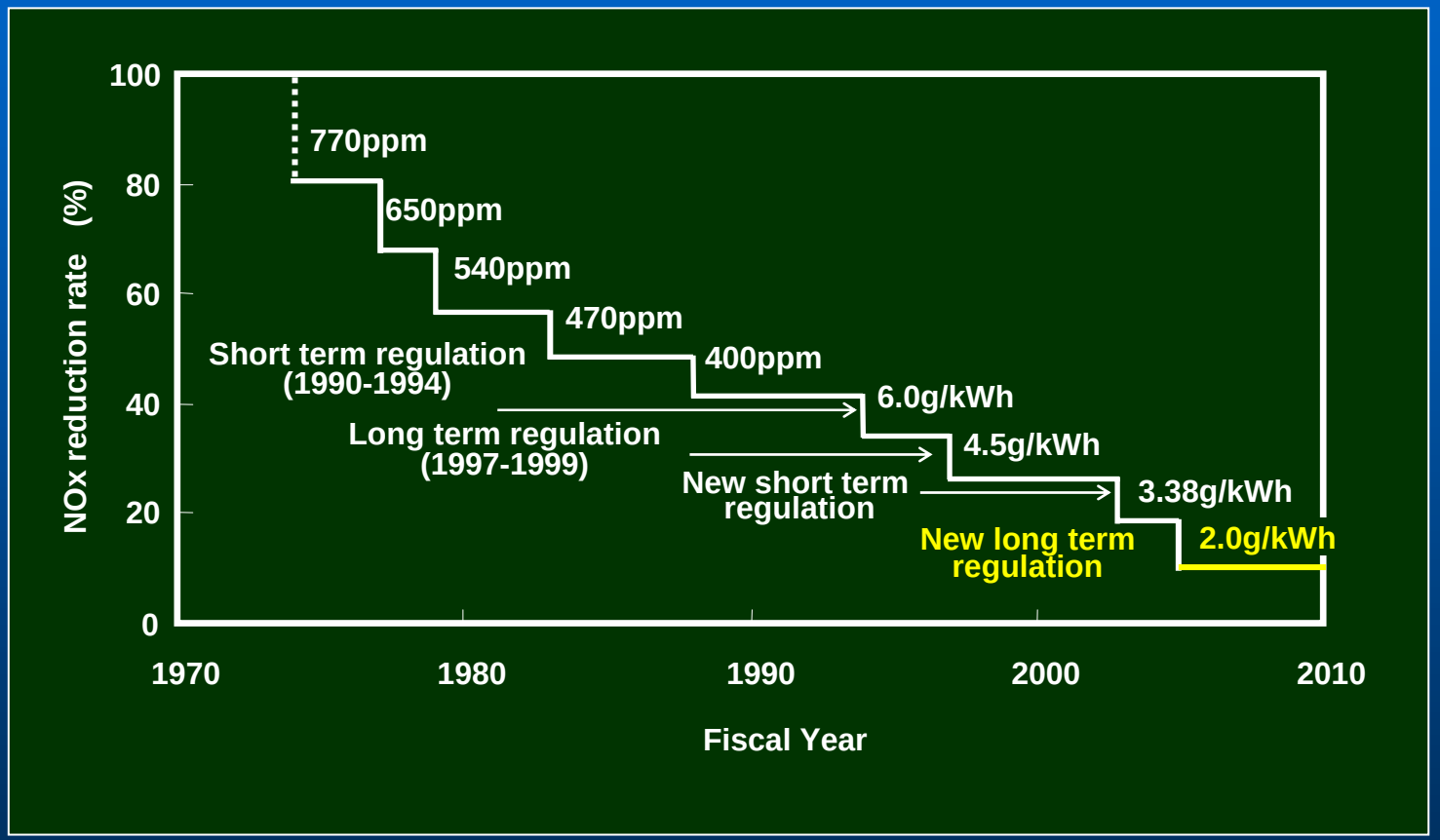
Category		Test Mode	Gas Component	Current regulation (Long term)		3rd.Recommendation (New short term)		Note
				Fiscal year	Value	Fiscal year	Value	
diesel truck, bus	(GVW≦1.7t)	10-15mode (g/km)	**CO**	1988	2.1	2002	0.63	
			HC		0.4	2002	0.12	
			NOx	1997	0.4	2002	0.28	
			PM		0.08	2002	0.052	
	(1.7t<GVW≦2.5t)	10-15mode (g/km)	**CO**	1993	2.1	2003	0.63	
			HC		0.4	2003	0.12	
			NOx	1997, 1998	0.7	2003	0.49	
			PM		0.09	2003	0.06	
	(2.5t<GVW)	D13mode (g/kWh)	**CO**	1994	7.4	2003, 2004	2.22	Current regulation: FY1997 2.5t＜GVW≦3.5t FY1998: 3.5t＜GVW≦12t FY1999: 12t＜GVW
			HC		2.9	2003, 2004	0.87	
			NOx	1997, 1998, 1999	4.5	2003, 2004	3.38	New short term: FY2003: 2.5t<GVW≦12t FY2004: 12t＜GVW
			PM	1997, 1998, 1999	0.25	2003, 2004	0.18	

New Long-term Target Values for diesel-powered Vehicles

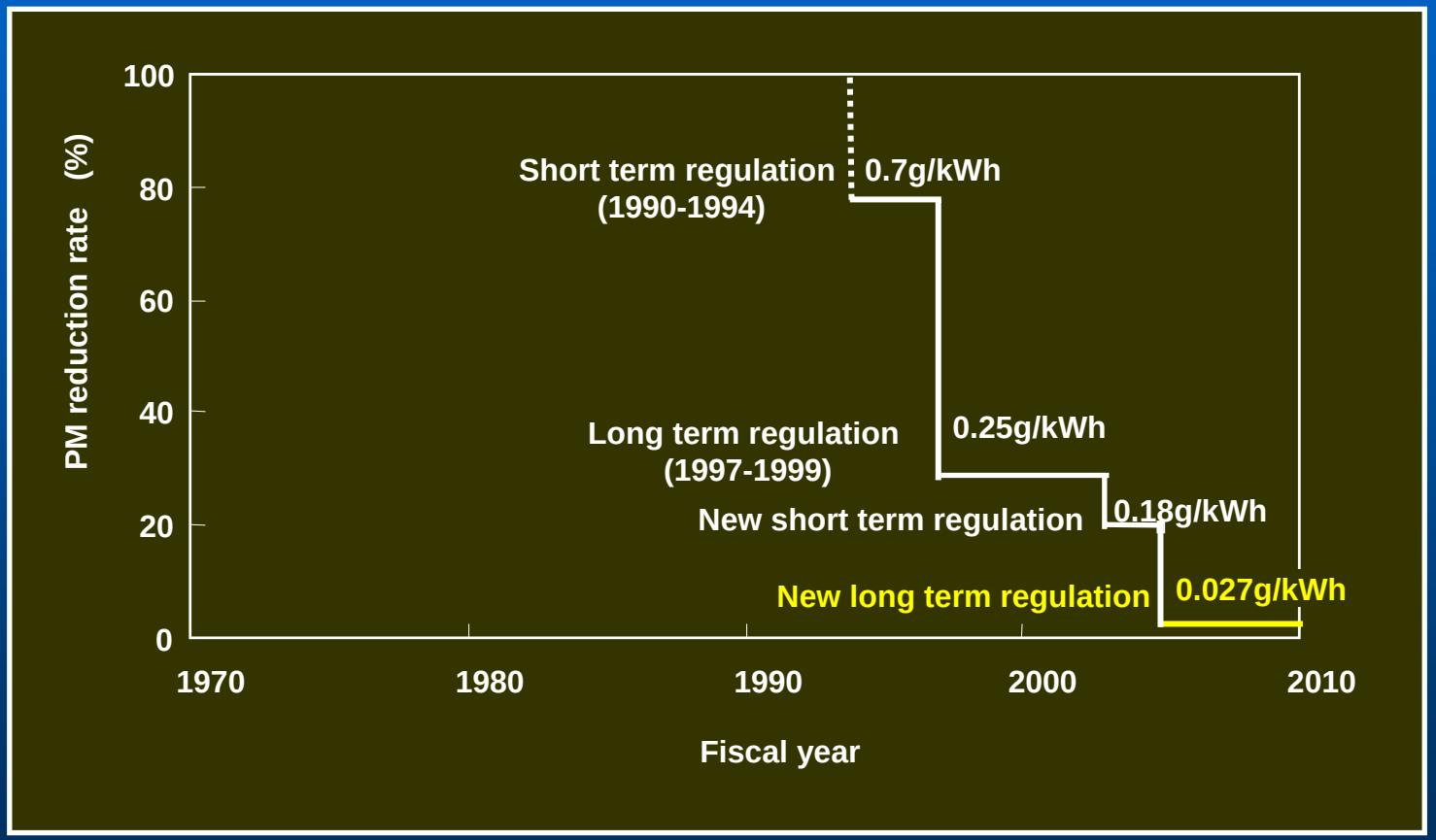
		PM	NOx	NMHC	CO	Achievement Timing
Passenger Cars	Small-sized	0.013	0.14	0.024	0.63	2005
	Medium-sized	0.014	0.15	0.024	0.63	2005
Trucks &Buses	Light-duty (Less than 1.7tons in GVW)	0.013	0.14	0.024	0.63	2005
	Medium-duty (over 1.7tons and lessthan 3.5tons in GVW)	0.015	0.25	0.024	0.63	2005
	Heavy-duty (Over 3.5tons in GVW)	0.027	2	0.17	2.22	2005

Notes: 1) Unit of target values: g/kWh (heavy-duty trucks & buses), g/km (all others).
2) GVW: Gross Vehicle Weight. NMHC: Non-methane Hydrocarbon

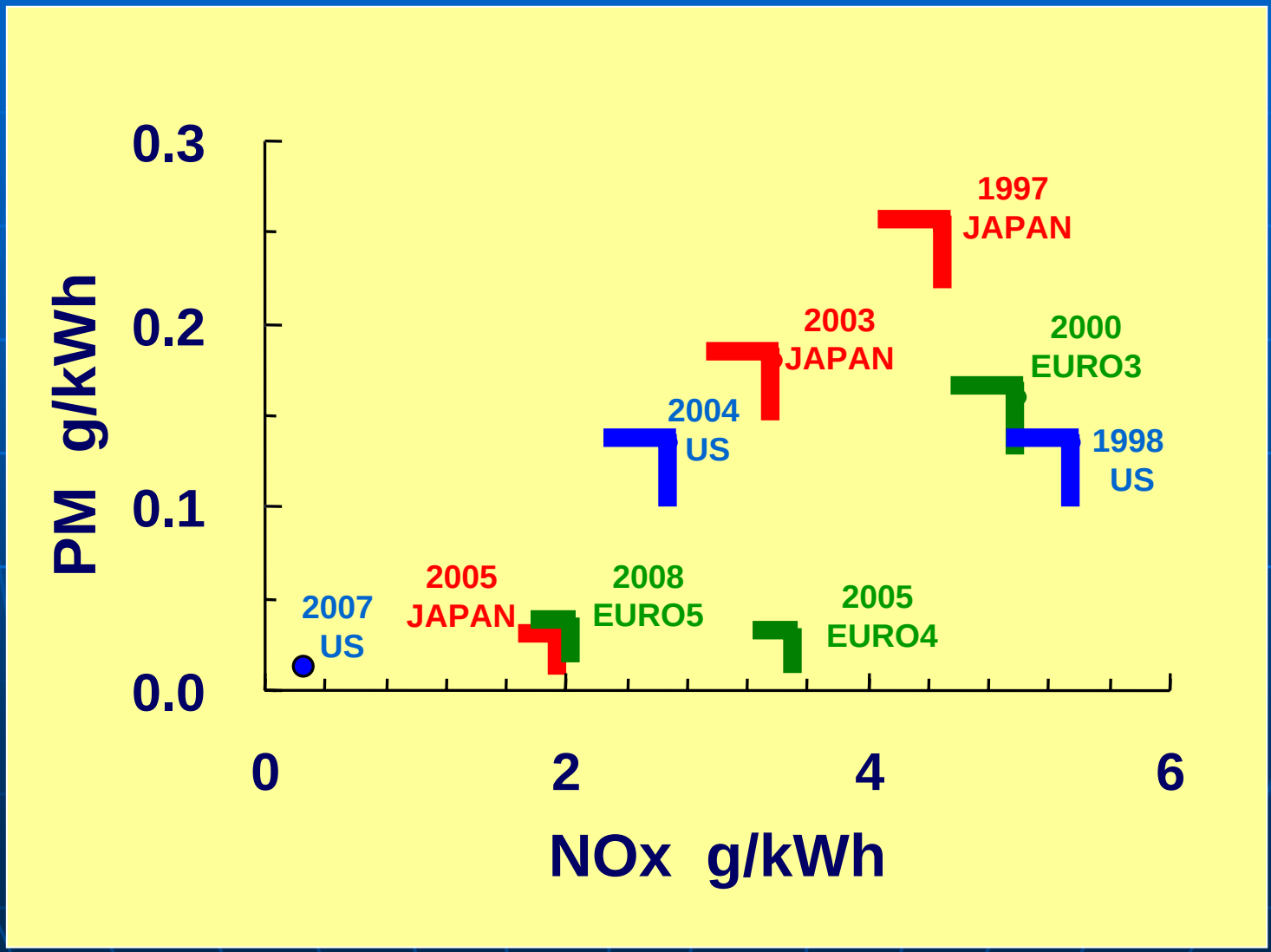
History of NOx regulations for heavy duty diesel vehicle



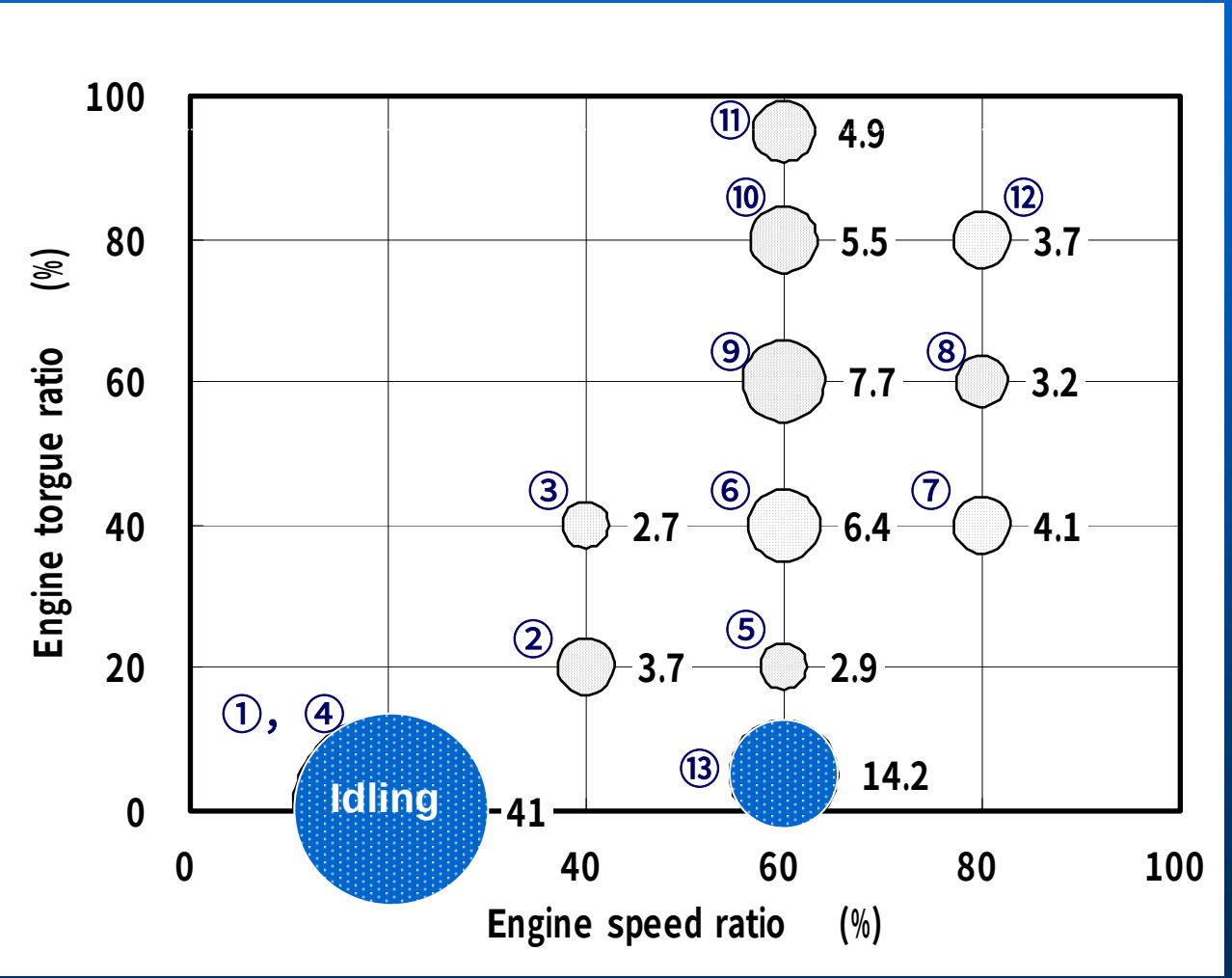
History of PM regulations for heavy duty diesel vehicle



Comparison of NOx and PM regulations for HD diesel vehicle among Japan, USA and Europe

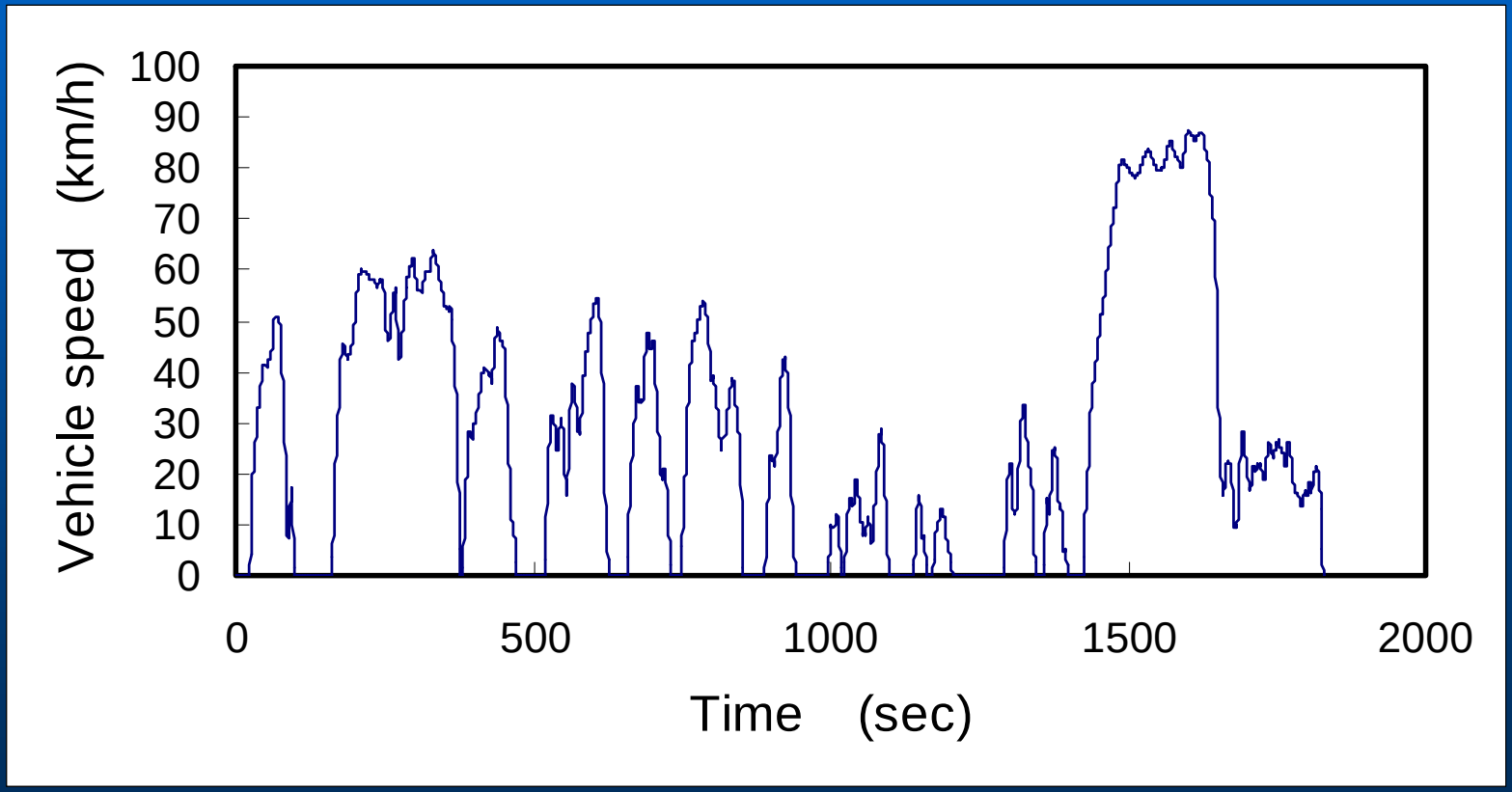


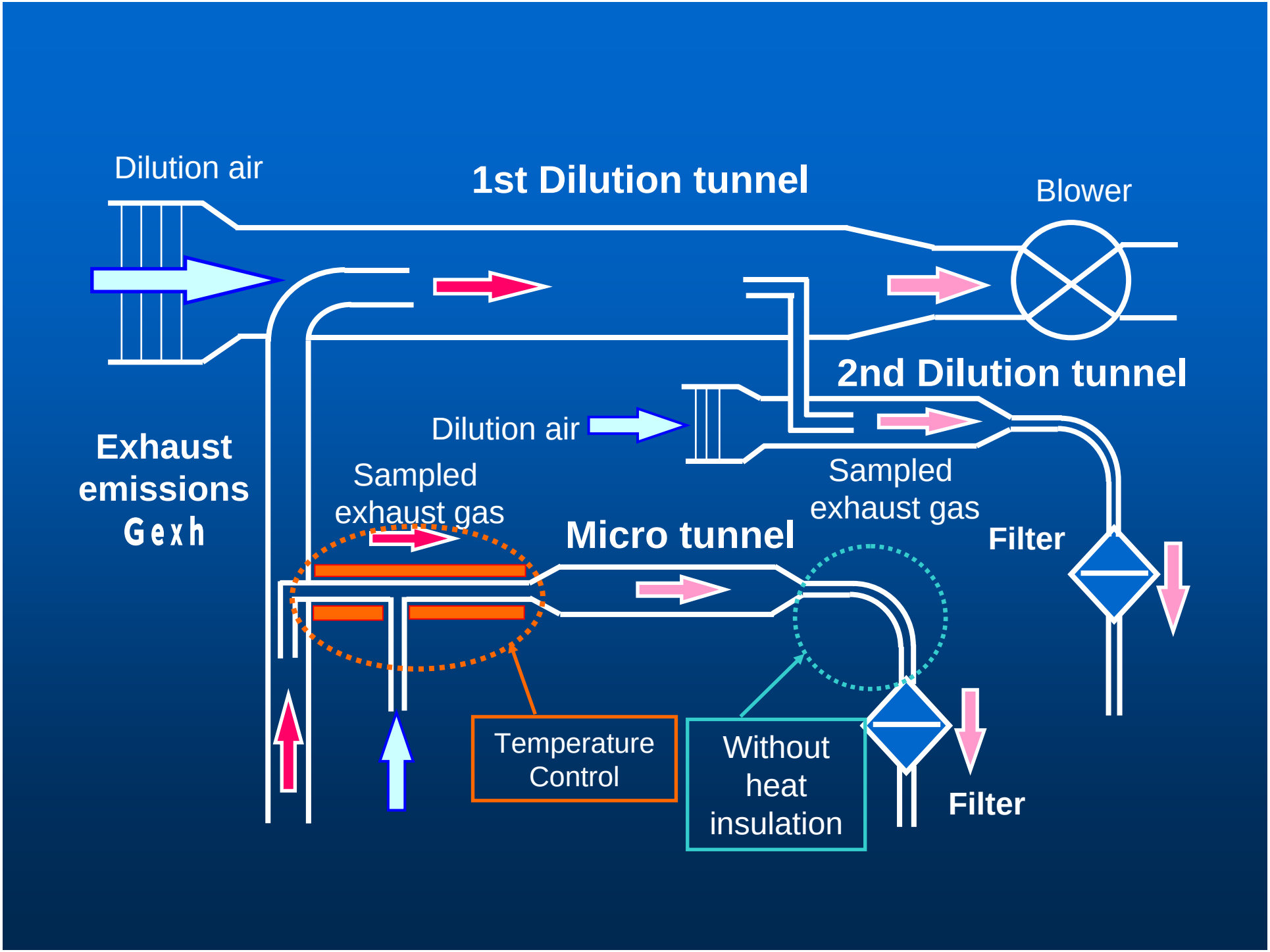
D-13 mode (Engine base exhaust emission test pattern for heavy duty diesel powered vehicle) (Steady-states, hot start)



Ref.: Each figures shows weighting factor of each mode.
Each circled figures shows the order of the engine operation points.

Representative driving mode for engine base emission test (vehicle with GVW over 3500kg)




Dilution air
1st Dilution tunnel
Blower
2nd Dilution tunnel
Dilution air
Exhaust emissions Gexh
Sampled exhaust gas
Micro tunnel
Sampled exhaust gas
Filter
Temperature Control
Without heat insulation
Filter

Measures for in-use vehicle emissions

Automobile NOx Law

- The levels of air pollution caused by NOx around major urban areas remain significant because of the increase in traffic volume and in the number of diesel-powered vehicles.
- "Law concerning Special Measures for total Emission Nitrogen Oxides from Automobiles in Specified Areas" (Automobile NOx Law) was enacted in June 1992.

Special NOx emission standard

- A special NOx emission standard has been introduced for designated diesel powered vehicles (trucks and buses, etc., which are registered in the specified areas).
- This standard will apply not only to new automobiles, but also, after a certain grace period to automobiles already in use.
- Designated vehicles not complying with the standard cannot be newly registered in the specified areas.
- In-use vehicles, which are not complying with the standard will not be approved at the time of inspection and thereafter will not be allowed in use.
- It becomes necessary for those vehicles to be replaced with vehicles which have less emission of NOx and meet the standard.

Automobile NOx /PM Law

➢Air pollution still remains in the same serious condition due to NOx and PM in the air,.

➢DEP carcinogenic nature has been pointed out.

- part of the" Automobile NOx Law" was partially revised in June 2000 toward further strengthening pollution control measures.

- PM is added as pollutant and diesel passenger car is included as “designated diesel powered vehicles”.

- The specified areas are also expanded.

to distinguish the new law from the old one, the new law is called

"Automobile NOx/PM Law"

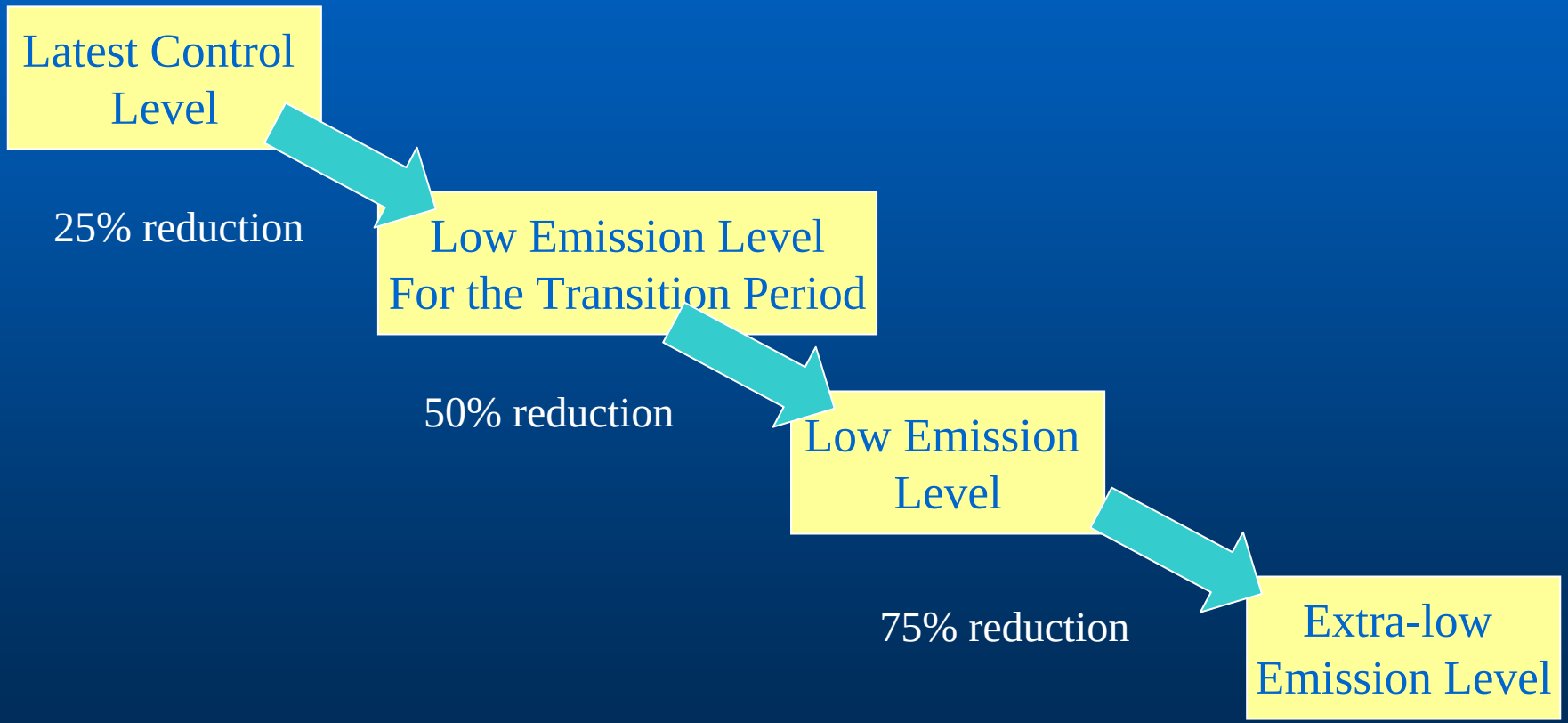
Guidelines of low emission vehicles

Technical Guidelines for Emission Control Technology for Low-emission Vehicles

- June 1995: the Environment Agency established the “Technical Guidelines for Emission Control Technology for Low-emission Vehicles” for electric vehicles, natural gas vehicles, methanol vehicles and hybrid vehicles.
- The exhaust emissions subject to these guidelines are CO, HC, NOx, PM, diesel black smoke, and formaldehyde (for methanol vehicle only). The primary objective is to reduce urban air pollution but also influence the policy of national and local governments in procuring official-use vehicles by encouraging replacement with lower-emission vehicles.
- January 1998: current technical guidelines were reviewed. In addition to the four types of low-emission vehicles, clean gasoline- or LPG-fueled vehicles with low NOx emissions have also been developed recently. In view of this fact, the committee report presents technical guideline values for exhaust emissions from all motor vehicles.
- These technical guideline values are targets for technical development, and serve as new indicators for emission control performance (cleanliness).

Vehicles with GVW of 3.5t or less

Three levels of emission values are set based on the next emission regulations for gasoline- and LPG-fueled motor vehicles to be enforced between the years 2000 and 2002.



25% Reduction
from Current Regulation

50% Reduction
from Current Regulation

75% Reduction
from Current Regulation

85% PM Reduction
from Current Regulation
(0.027g/kWh)

75% PM Reduction
from Current Regulation
(0.05g/kWh)

※ 2003 Regulation: 0.18g/kWh

CONCLUSION

- The present status of air pollution by automobiles in Japan and various government policies for improving these situations were introduced.
- According to demand for environmental improvement, automobile exhaust emission regulations have been introduced and tightened step by step.
- However, continuous growth in the number of vehicles has overcome the effect of regulations such that environmental NOx and SPM still pose a grave threat.
- Further strategy is required toward the near future to solve these environmental problems.