

Japan's Automotive Emissions Regulations and Emissions Control Technologies for 2005 and Later

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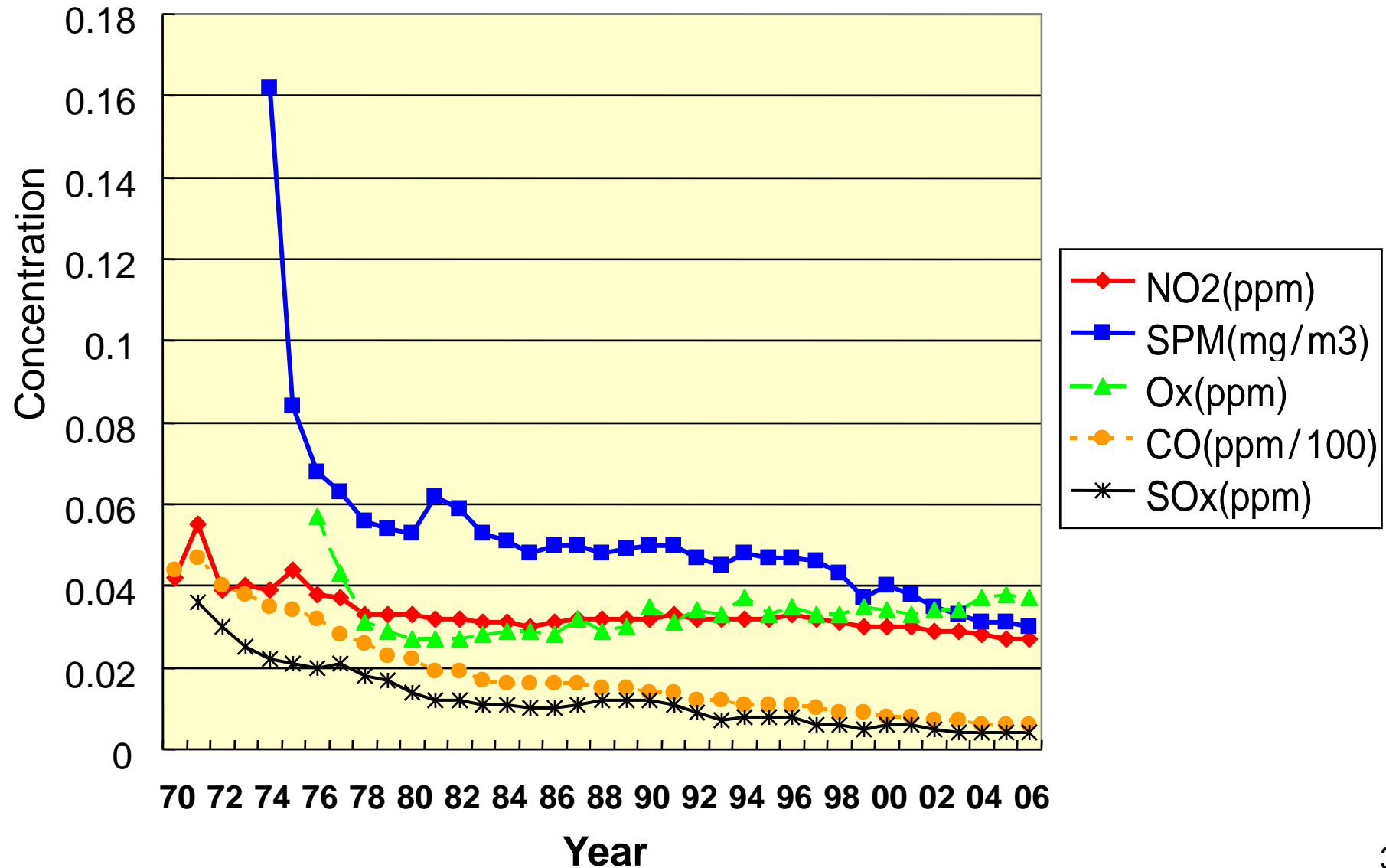
1 . Current Status of Air Pollution

2 . Automotive Emissions Regulations

3 . Automotive Emissions Control
Technologies

Trends in Annual Average of Air Pollutants in Japan

(Average of Roadside Monitoring Stations)



Attainment Rate of Environmental Quality Standard in 2006

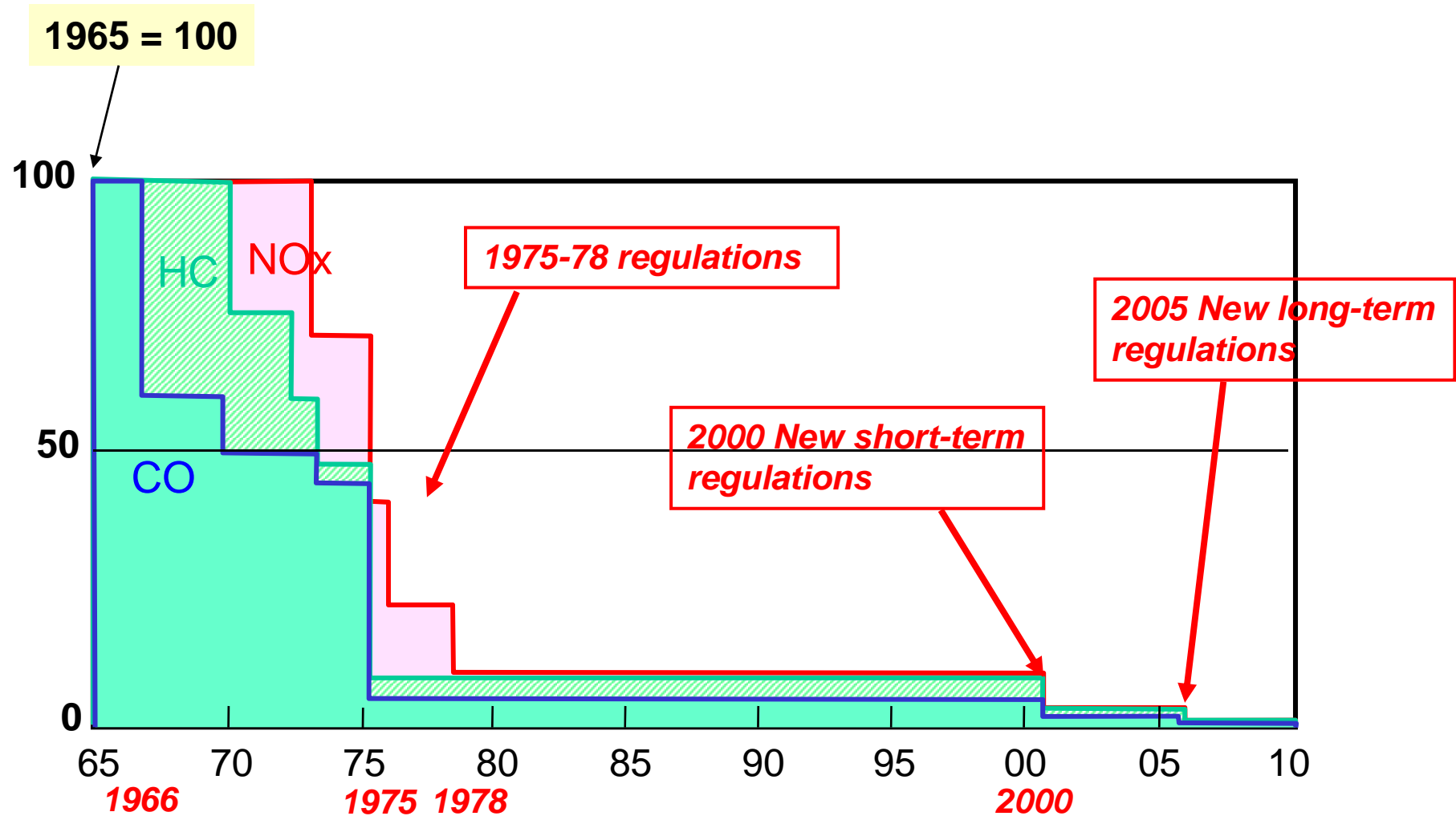
		General Monitoring Station	Roadside Monitoring Station
NO2	All Regions	1 0 0 %	9 0 . 7 %
	Nox・PM Law Measures Regions	1 0 0 %	8 3 . 7 %
SPM	All Regions	9 3 . 0 %	9 2 . 8 %
	Nox・PM Law Measures Regions	9 6 . 7 %	9 2 . 1 %
Oxidant	All Regions	0 . 1 %	3 . 7 %
SO2	All Regions	9 9 . 8 %	1 0 0 %
CO	All Regions	1 0 0 %	1 0 0 %

1 . Current Status of Air Pollution

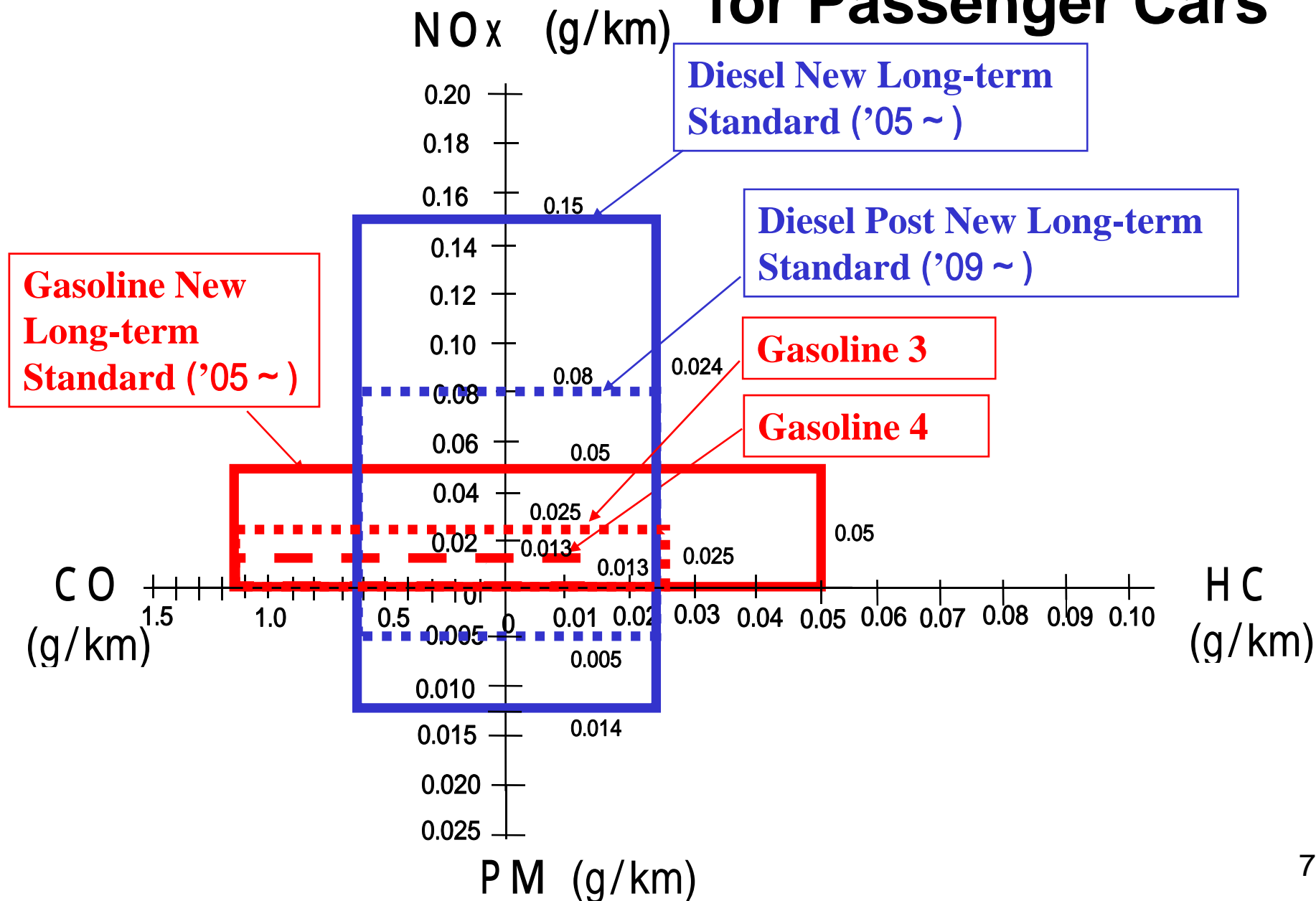
2 . Automotive Emissions Regulations

3 . Automotive Emissions Control
Technologies

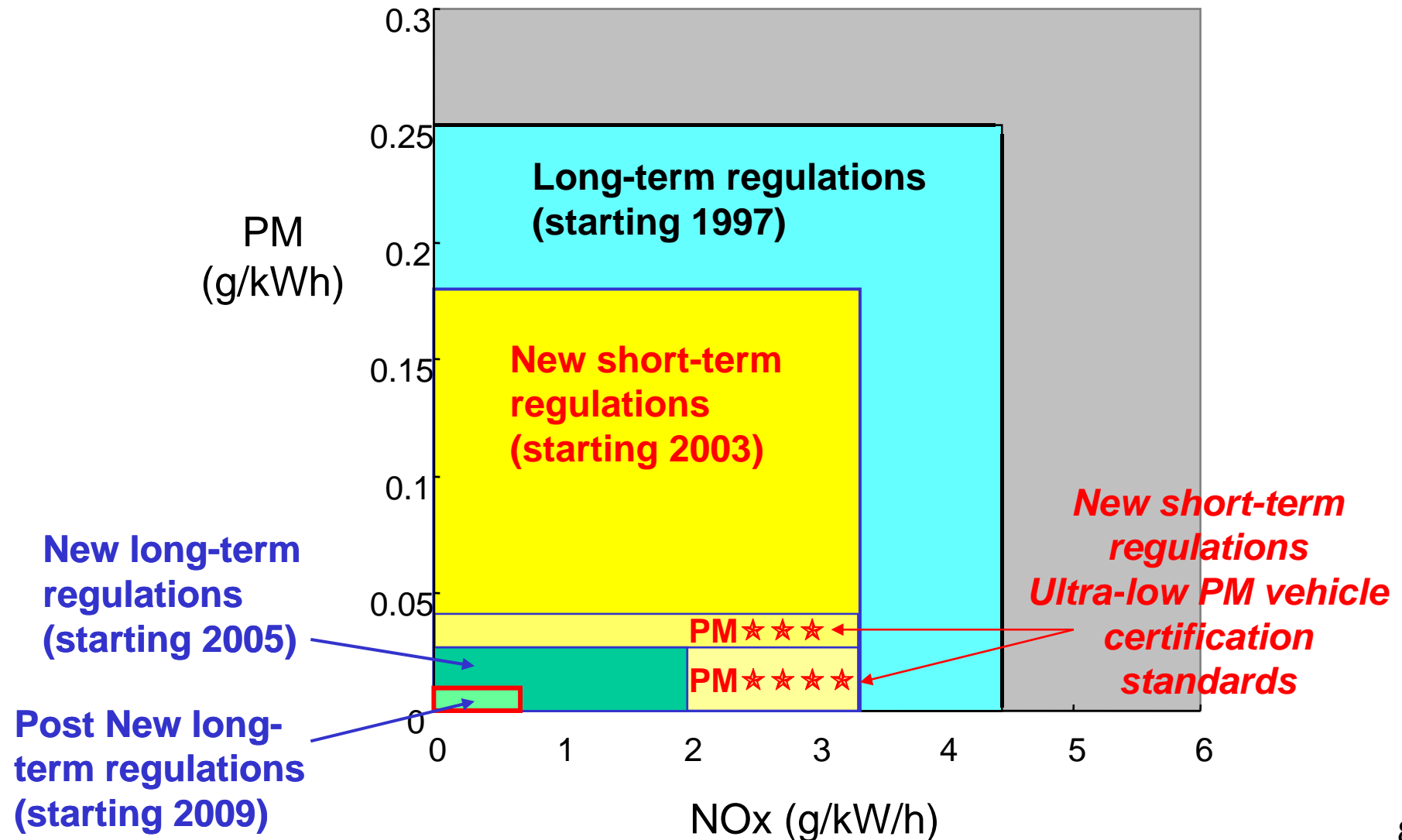
Emissions Regulations for Gasoline Passenger Cars in Japan



Exhaust Emissions Standards for Passenger Cars

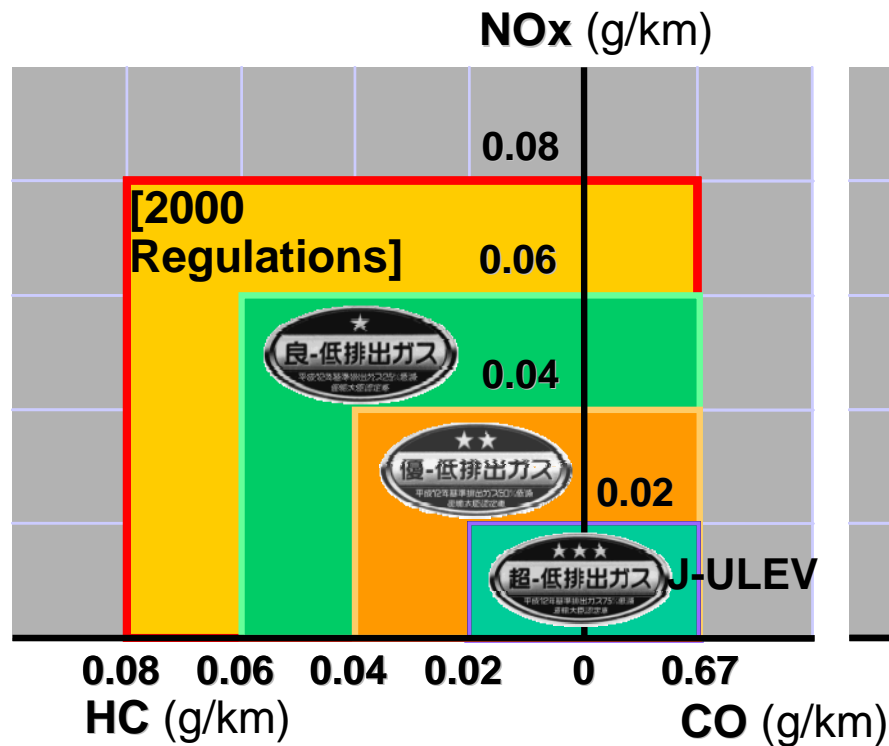


Emissions Standards for Heavy-duty Diesel Vehicles

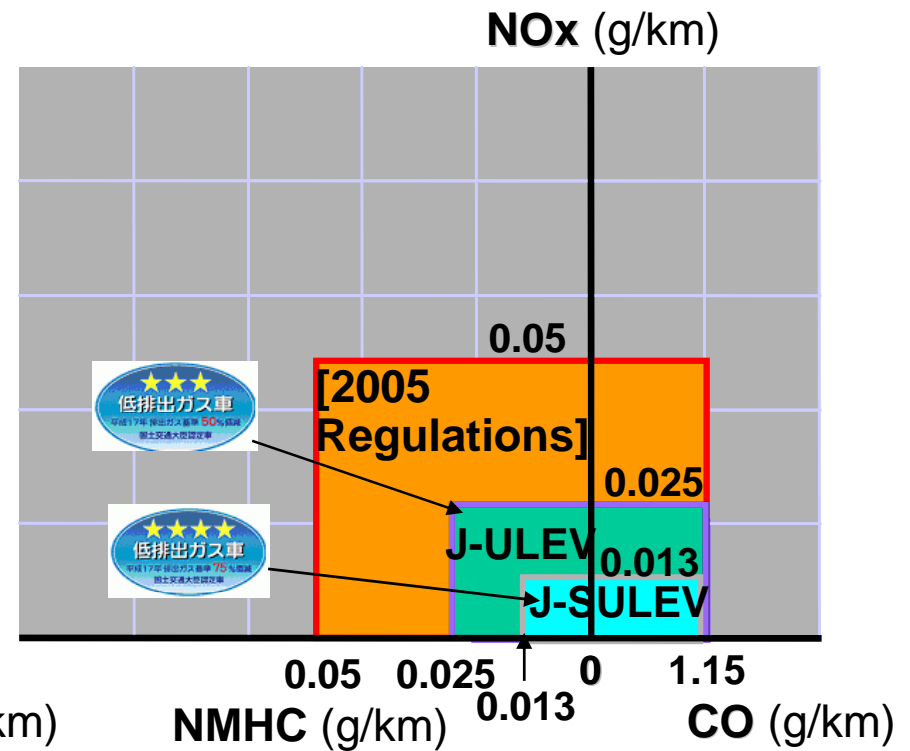


Low Emission Vehicle Certification System

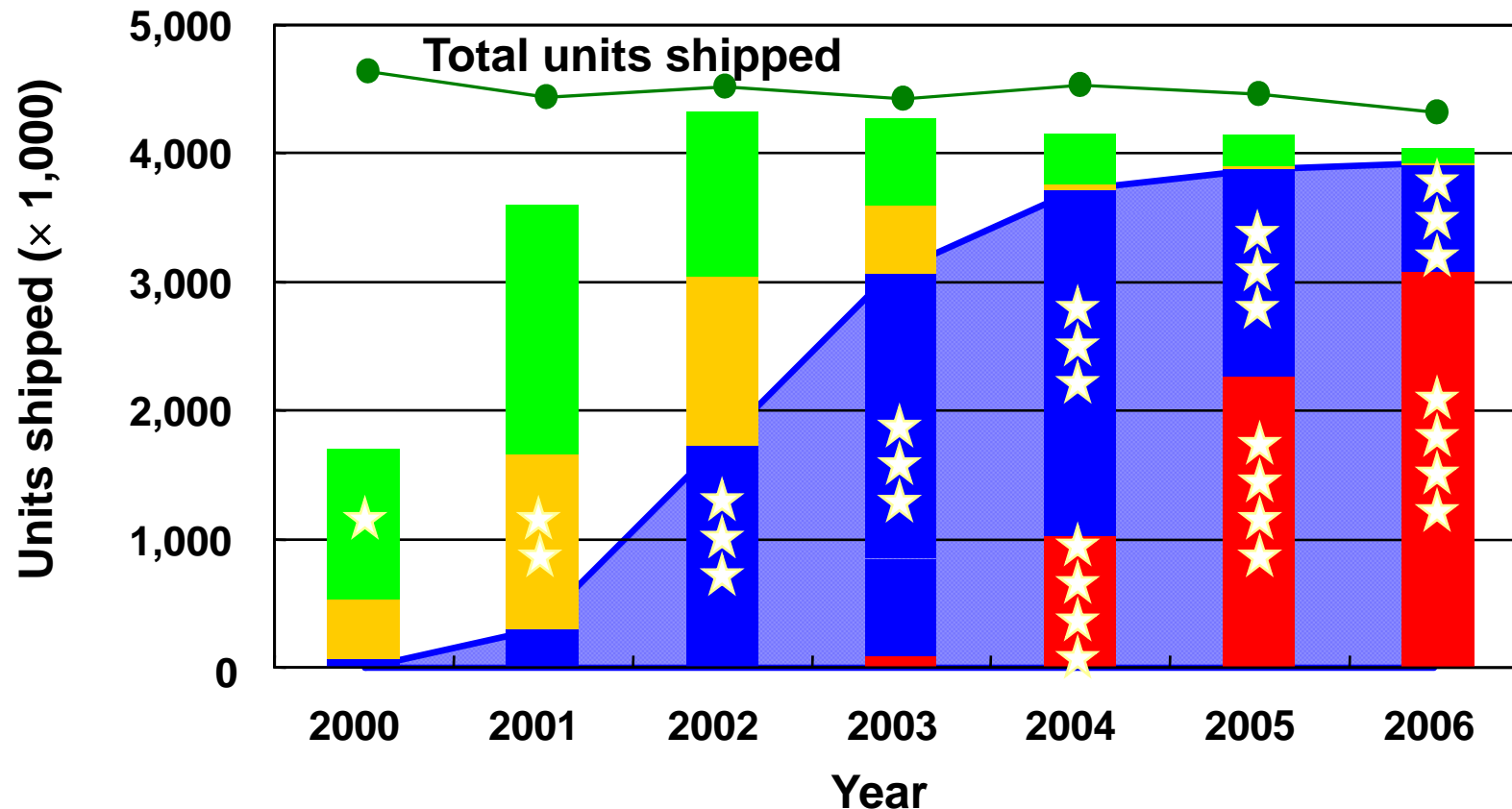
10-15 Mode



Combined Mode

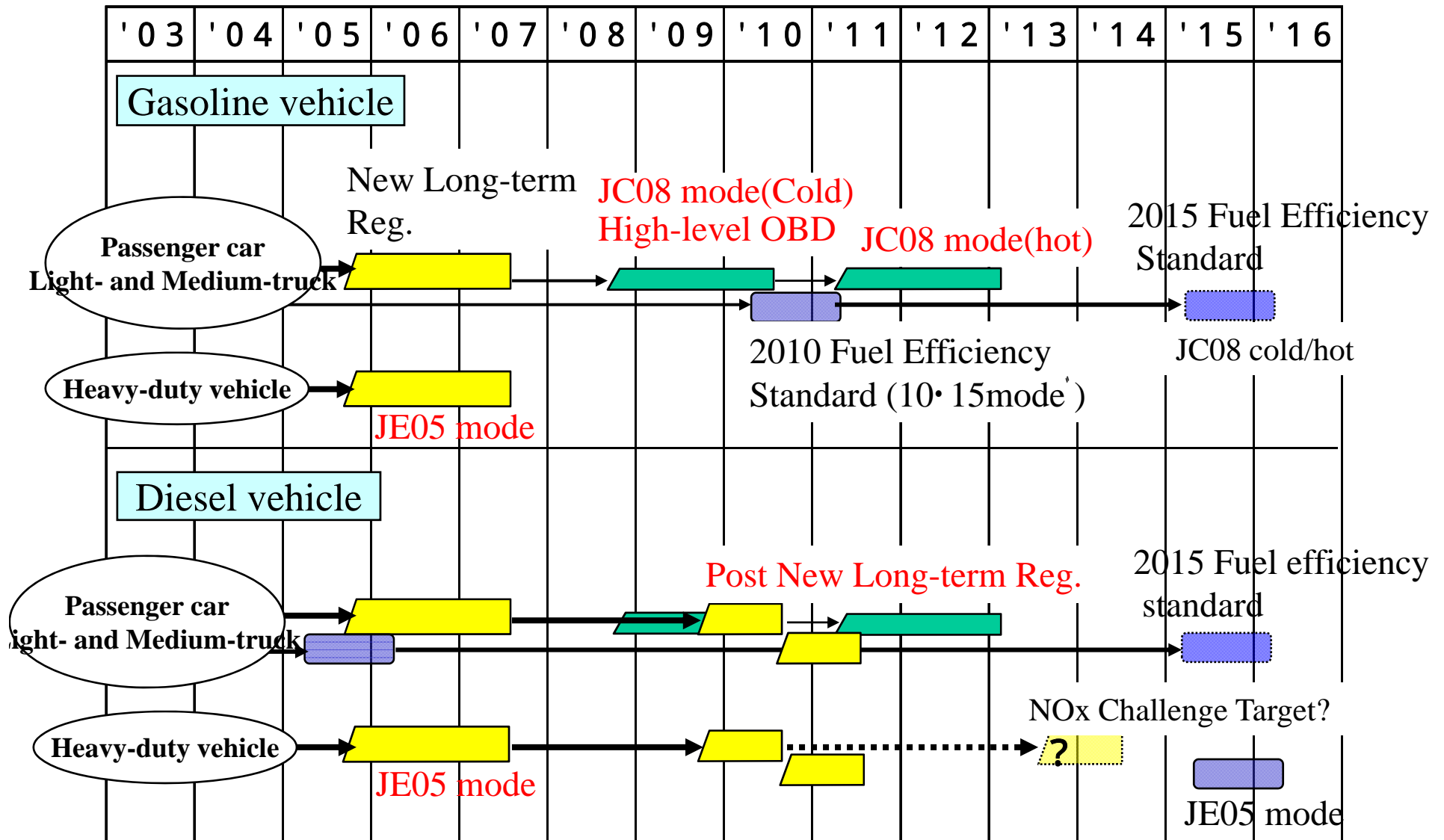


Introduction of Certified Low Emission Passenger Cars in Japan



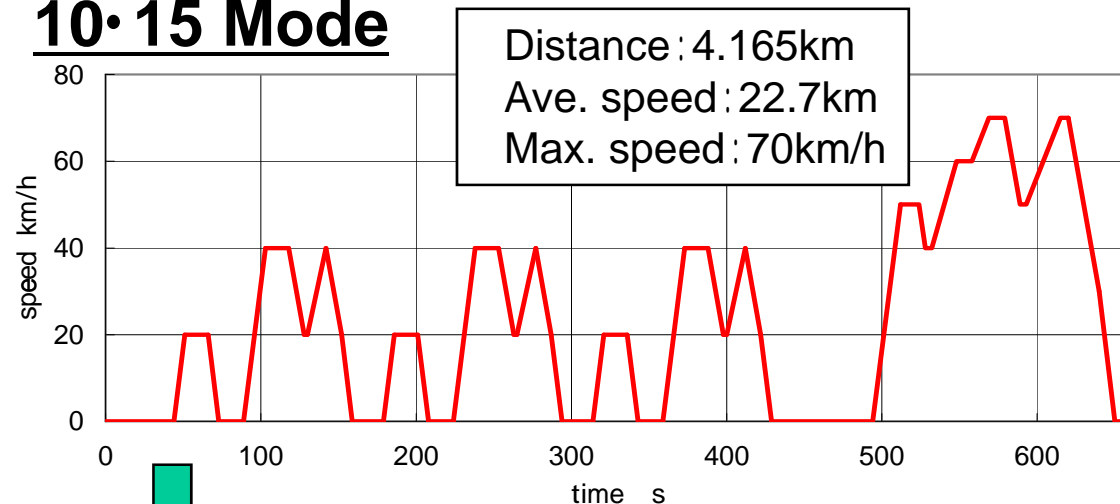
3.9 million low emission vehicles (3 , 4) shipped in 2006, 90% or more of all passenger cars

Future Automotive Emissions Regulations in Japan

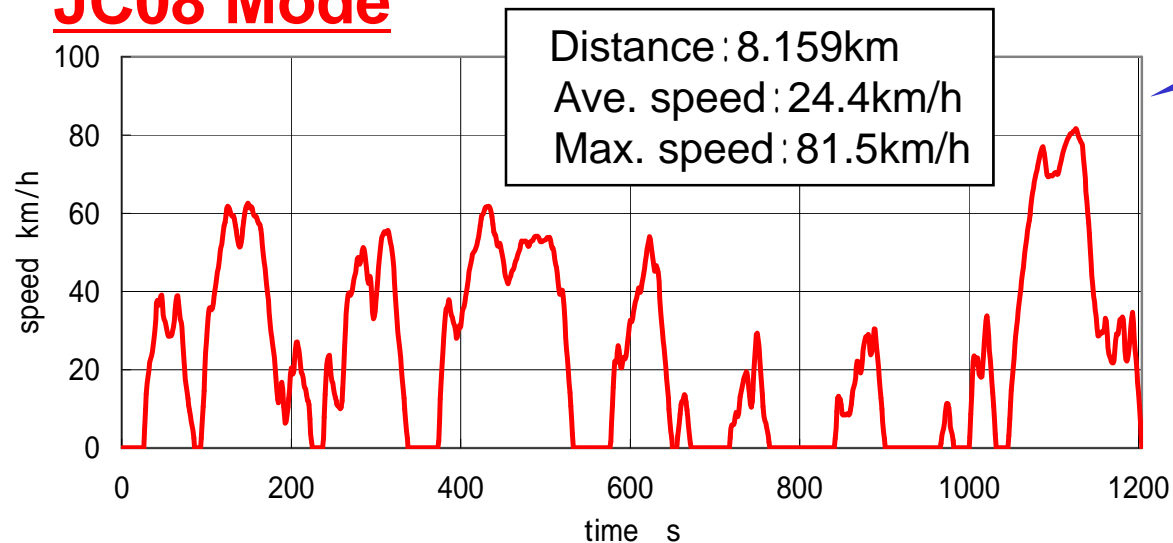


New Emission Test Mode (**JC08 Mode**) for Vehicles with GVW of 3,500kg or less

10·15 Mode



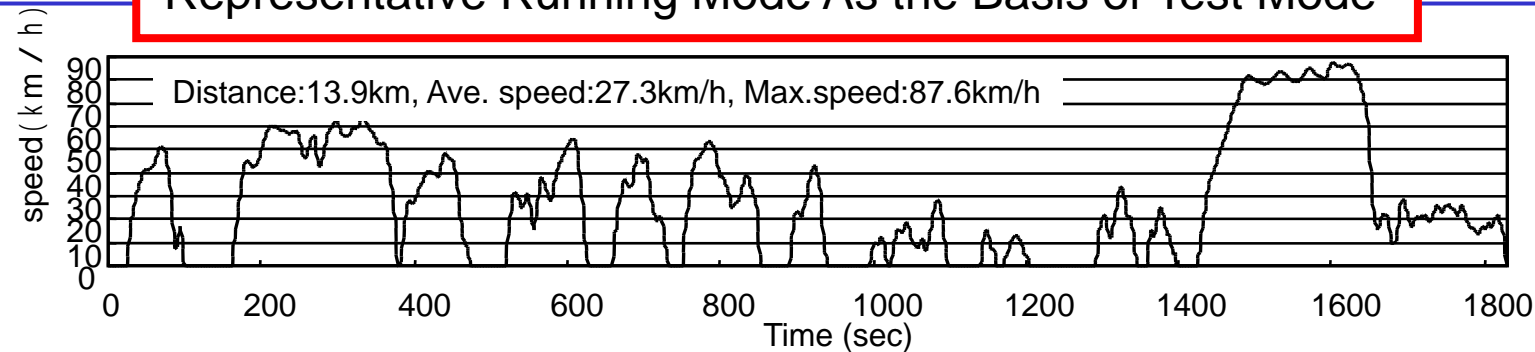
JC08 Mode



In order to accurately
assess
the performance of
exhaust emissions
in real world

New Emission Test Mode (**JE05 Mode**) for Vehicles with GVW of over 3,500kg

Representative Running Mode As the Basis of Test Mode

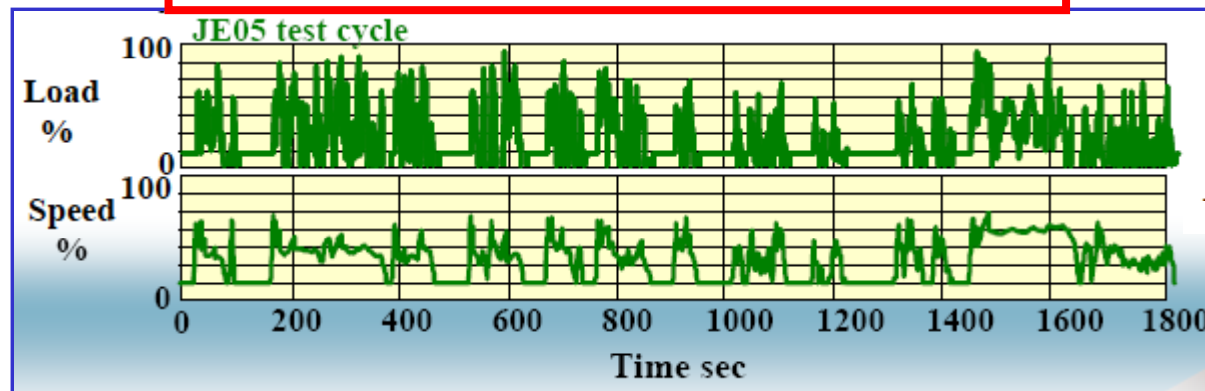


Actual Max. Torque Curve Measured Data

Vehicle Specification Data

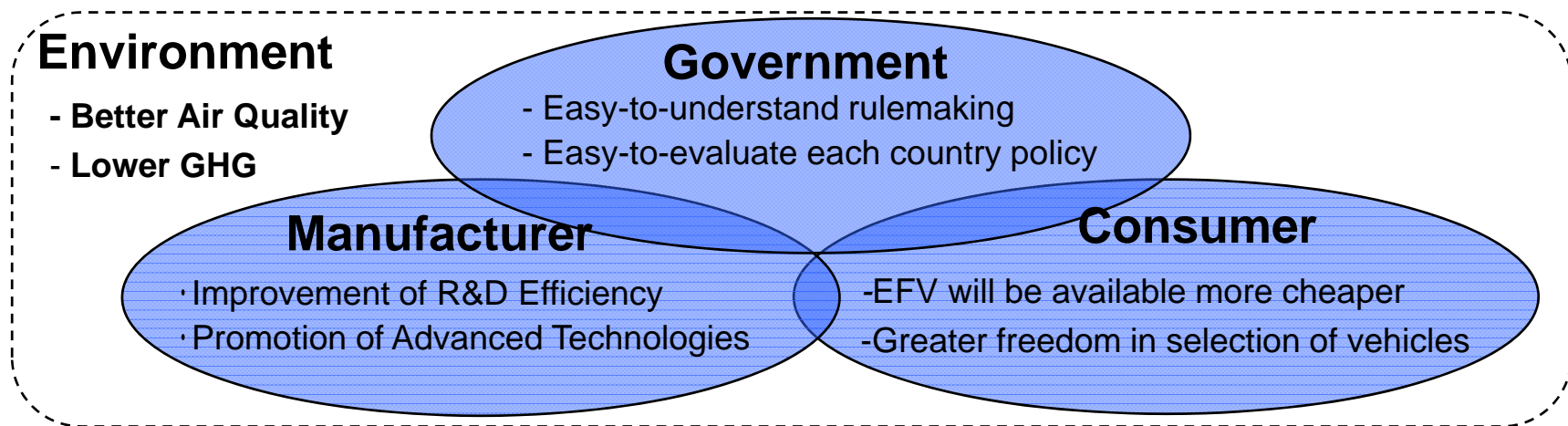
Simulation

Conversion to Engine RPM and Torque



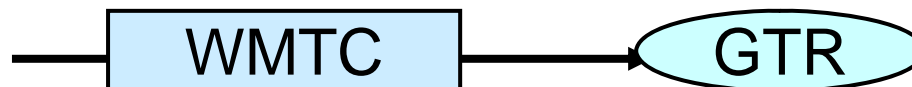
Engine Operation
on
Engine
Dynamometer

Worldwide Harmonization of Emission Test Procedure



UN/ECE/WP.29

Motorcycle



Heavy-duty Vehicle



Light-duty Vehicle



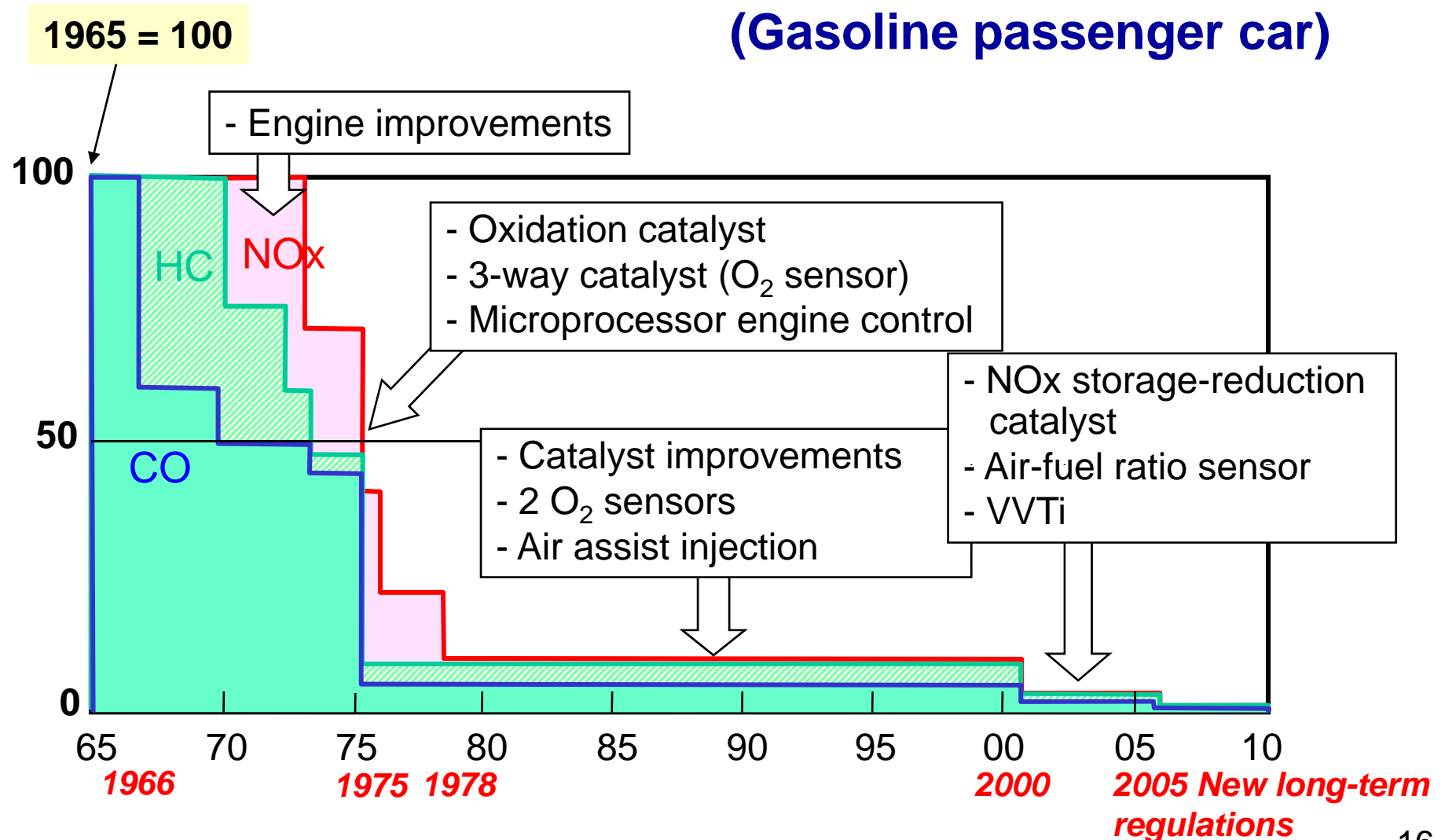
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Technologies**

Emissions Regulations and Main Control Technologies in Japan

(Gasoline passenger car)



Emissions Control Technologies (Gasoline vehicles)

Reduction Technology		NOx	HC
Cold emission	Move catalyst forward	○	○
	Cascade catalyst	○	○
	HC adsorption system		○
	Supercharging	○	○
	Double-wall exhaust manifold	○	○
	VVT	○	○
	Better control of transient A/F	○	○
	Reduce crevice volume		○
	Improve catalyst	○	○
Hot emission	Strengthen swirl		○
	Increase catalyst size and carrier volume	○	○
	Improve NOx catalyst	○	
	Electronically controlled EGR	○	

Future Technologies to Reduce Emissions from Gasoline Vehicles

Points: Improve combustion, Warm up faster, Activate catalyst faster, Restrain deterioration, Improve control

● Develop engine control

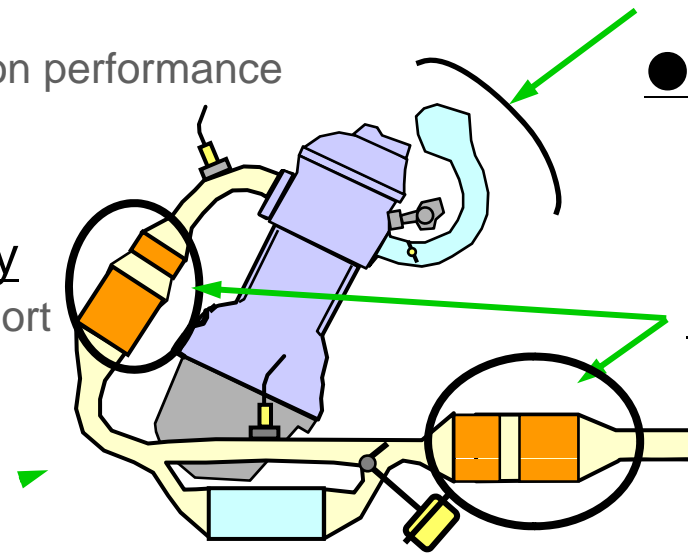
- Develop control technology
 - Increase control precision for A/F ratio, ignition timing
 - Improve OBD detection performance
- Develop control parts
- Develop sensors

● Use thermal energy

- Heat cylinder head, port
- Heat intake air etc.

● Develop exhaust system parts

- Reduce heat capacity
- Secondary air
- Control exhaust temperature



● Improve engine combustion

● Develop valve mechanism

● Improve catalyst performance

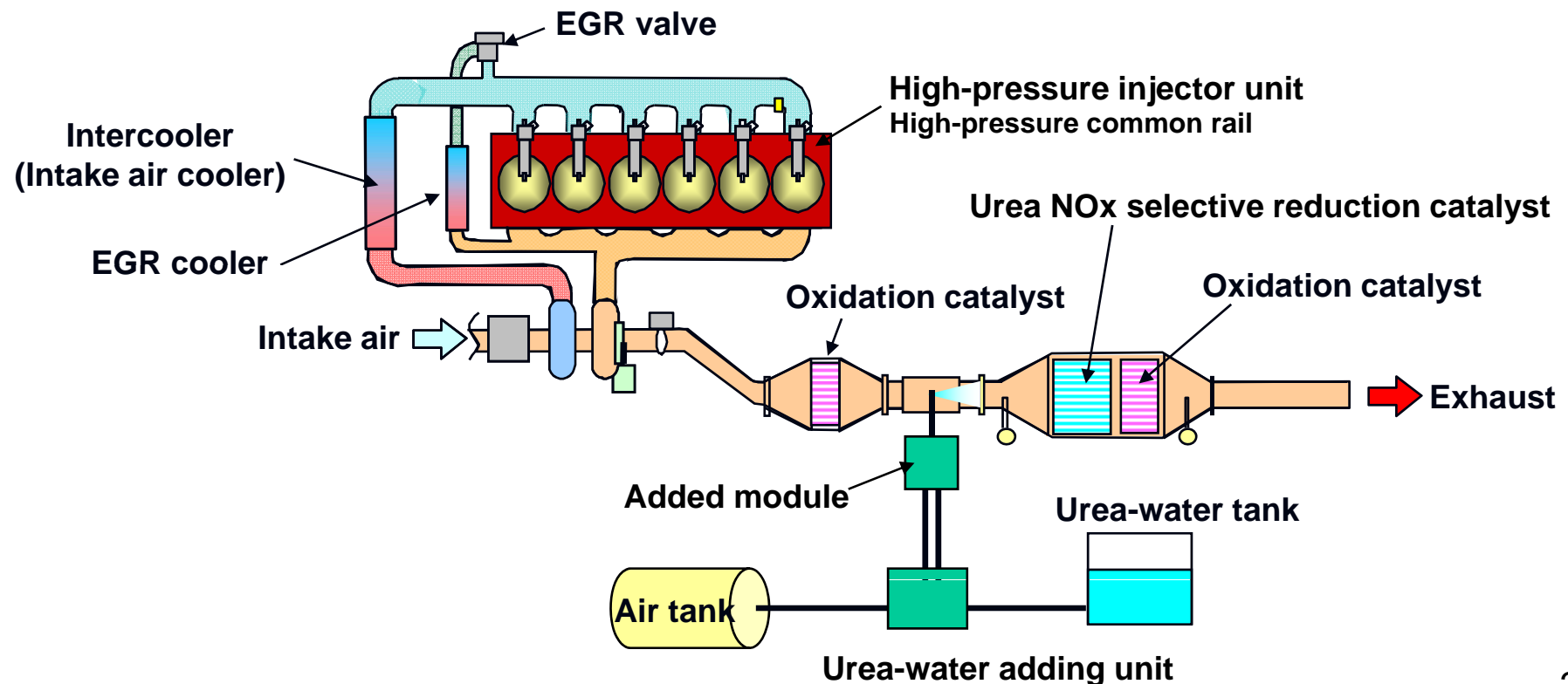
- Improve catalyst
 - Low-temperature activation
 - Good heat resistance
- Adsorption purification catalyst
- New catalysts

Diesel Emissions Control Technologies

Year			'74	'77	'79	'83	'89	'94	'98	'03
Emissions Regulations								Short-term	Long-term	New Short-term
Engine	Fuel injection system	Retarded injection timing	●	●	●	●	●	●	●	●
		Improved injection nozzle			●	●	●	●	●	●
		Higher injection pressure	●	●	●	●	●	● CR, UI	●	●
		Variable injection rate				●	●	●	●	●
		Multi-injection (common rail, etc.)						●	●	●
		Improved combustion chamber	●	●	●	●	●	●	●	●
	Intake system	Supercharger with intercooler			●	●	●	●	●	●
		Inertial supercharging, Supercharger with W/G, etc.			●	●	●	●	●	●
		Variable nozzle turbocharging					●	●	●	●
		Variable swirl						●	●	●
	EGR system	EGR	Internal EGR						●	●
			External hot EGR						●	●
			Cooled EGR						●	●
Aftertreatment	PM reduction	Oxidation catalyst							●	●
		DPF								●
	NO _x reduction	NO _x catalyst								●

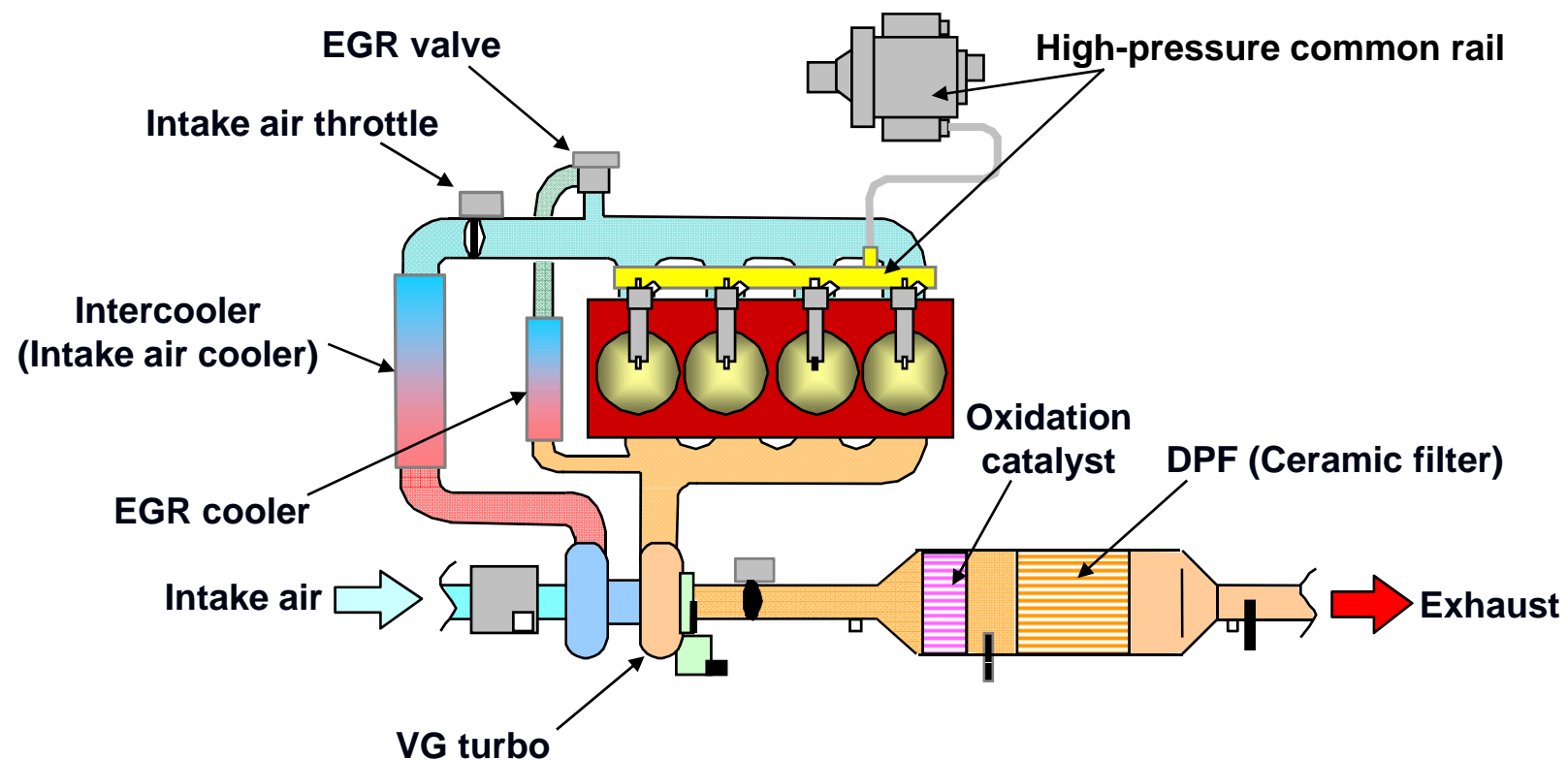
Diesel Emission Control Technologies for New Long-term Regulation (1)

Urea selective reduction catalyst (SCR) + High-pressure fuel injection unit + Cooled EGR



Diesel Emission Control Technologies for New Long-term Regulation (2)

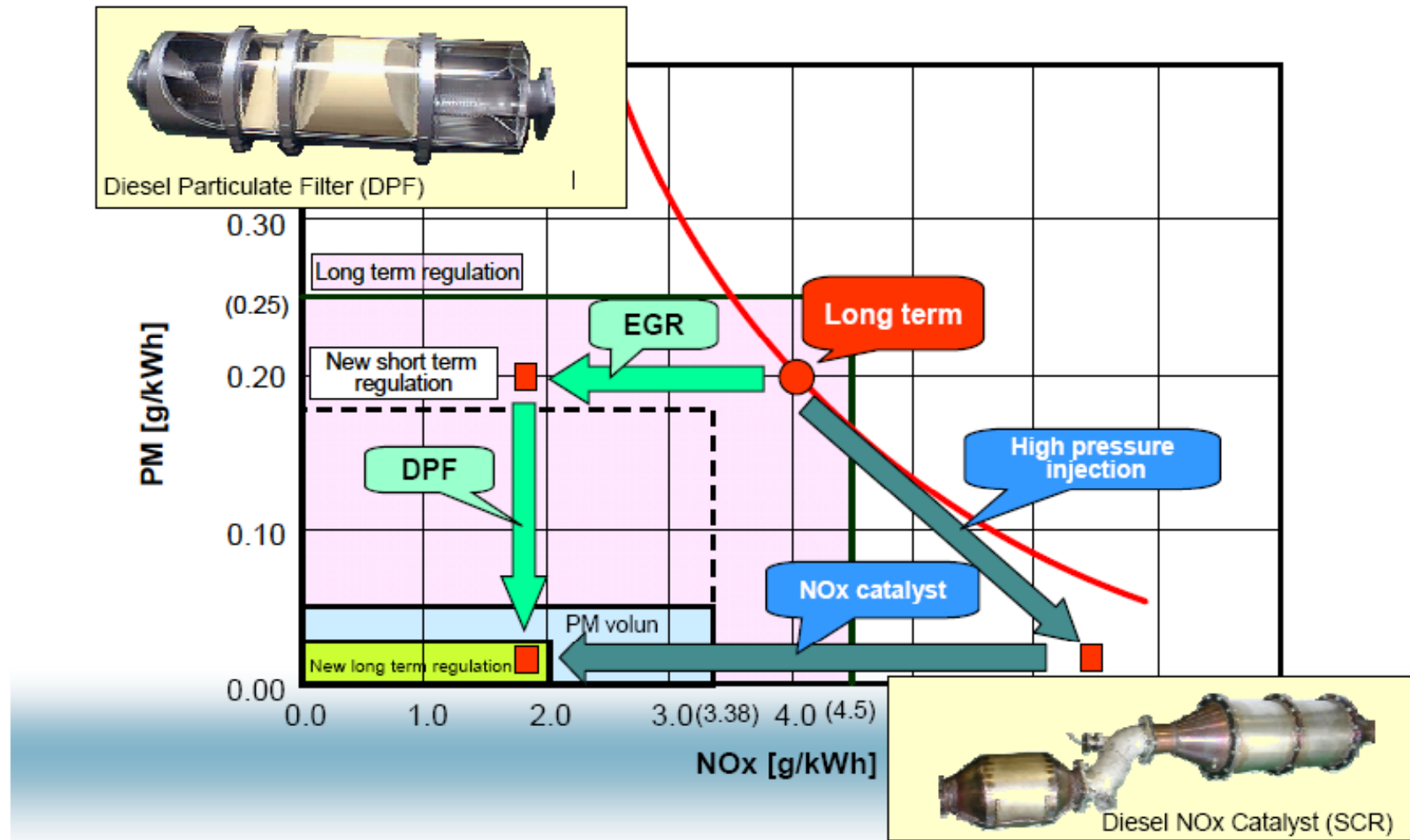
DPF + High-pressure fuel injection unit + Cooled EGR



Corresponding technologies for post new long term regulation (JP 2009)

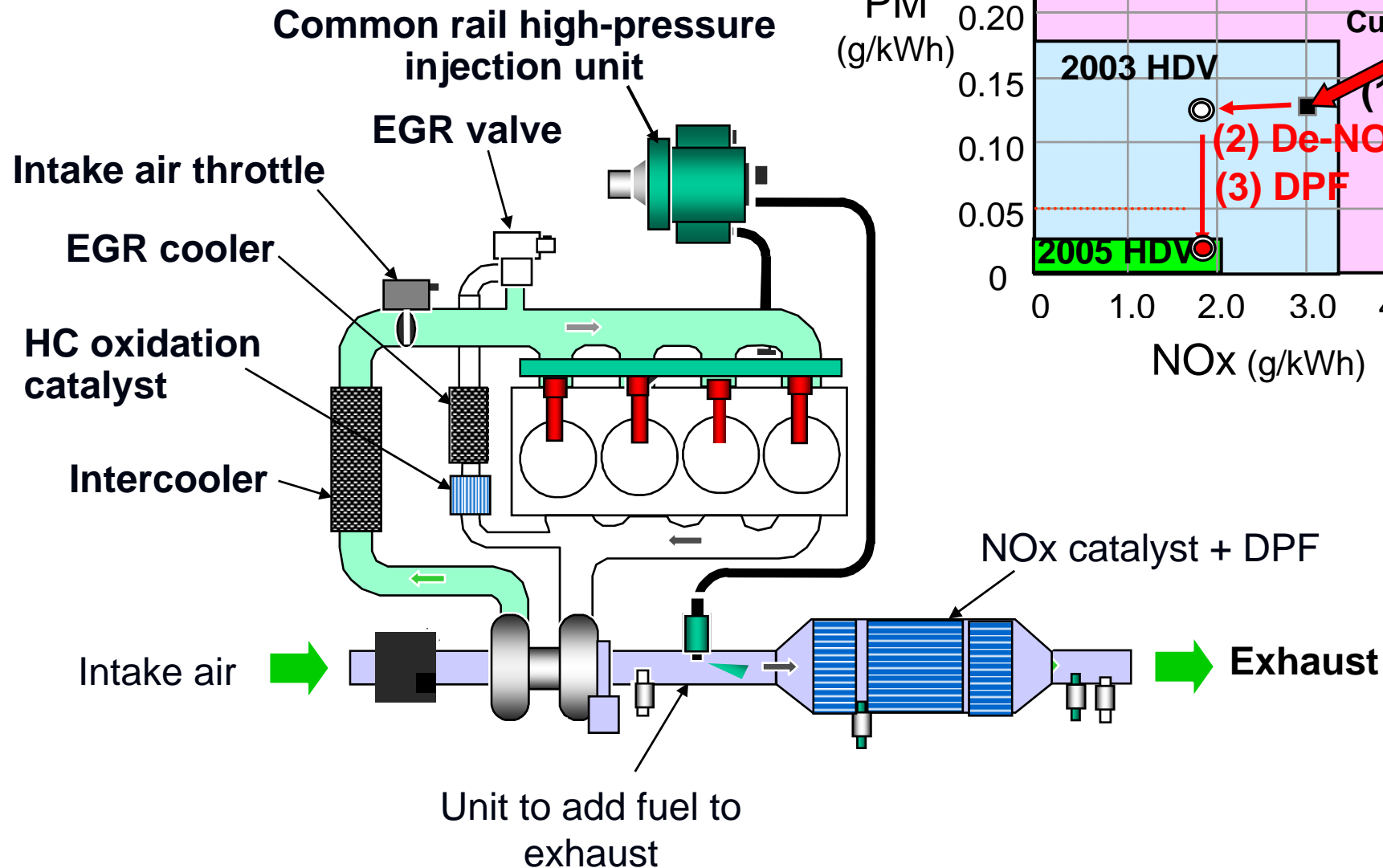
- **Engine modification**
 - High pressure injection
 - Cooled EGR
 - Combustion improvement
- **After Treatment System (ATS)**
 - DPF / NOx catalyst (SCR, NOx trap)
 - Exhaust temperature / Oxygen concentration
- **Sophisticated control for engine and ATS**

Technology for diesel emission reduction in Japan

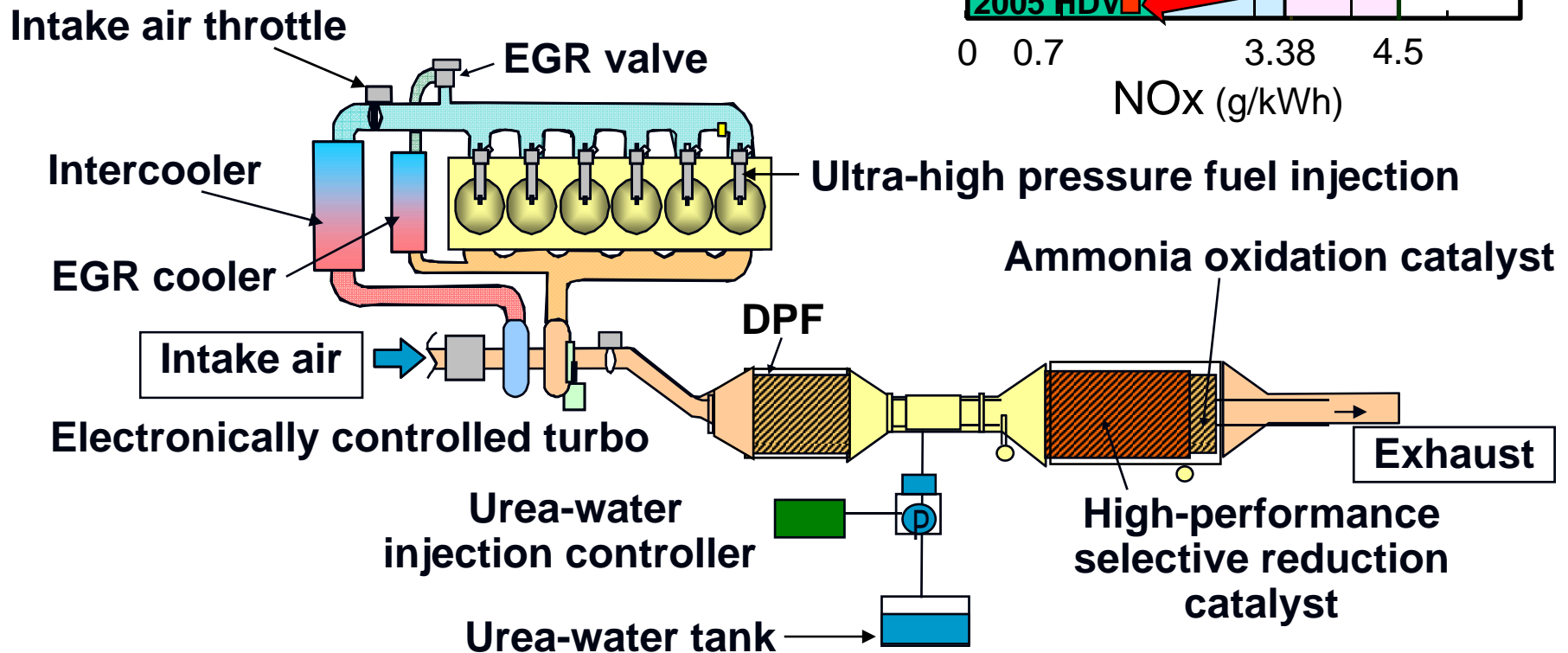
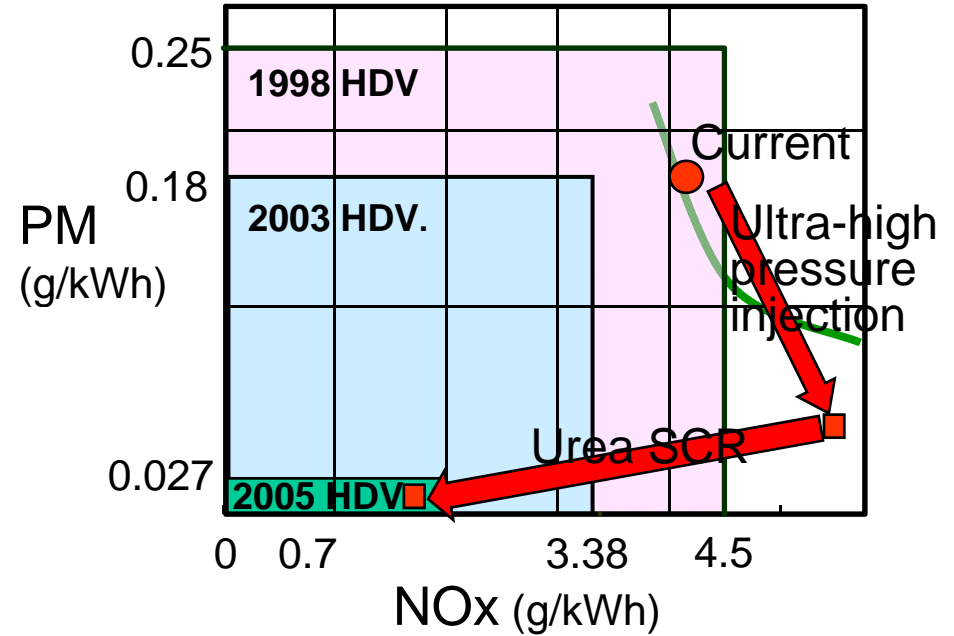


Future Diesel Emission Control Technology

(1) DPF + NOx storage-reduction catalyst system



(2) Urea SCR System



ATS characteristics for post new long term regulation

Item			DPF+LNT	DPF+SCR
Main Components	PM reduction	PM filter	Ceramic Filter	←
		Active regeneration device	CRS, etc	←
	NOx reduction	NOx catalyst	LNT	SCR
		reductant	Fuel (diesel)	Urea
		Reductant additive device	Fuel additive	Urea additive
		Reductant tank	No need	Urea tank
Remarks	Influence on economical efficiency (ex. Fuel economy)		Fuel economy degradation owing to back pressure increase and fuel additive	<ul style="list-style-type: none"> Fuel economy degradation owing to back pressure increase Urea additive cost
	Cost		Costly metal in catalyst	New components regarding urea system (tank, anti-icing system, etc)
	Installation, Weight		Large size ATS	Large size ATS Urea system
	Infrastructure		No need	Need *

* Infrastructure at gas station, etc needed for light and medium duty vehicle



Thank you for your attention !