Introduction of JATOP and the current status regarding automotive fuels in Japan

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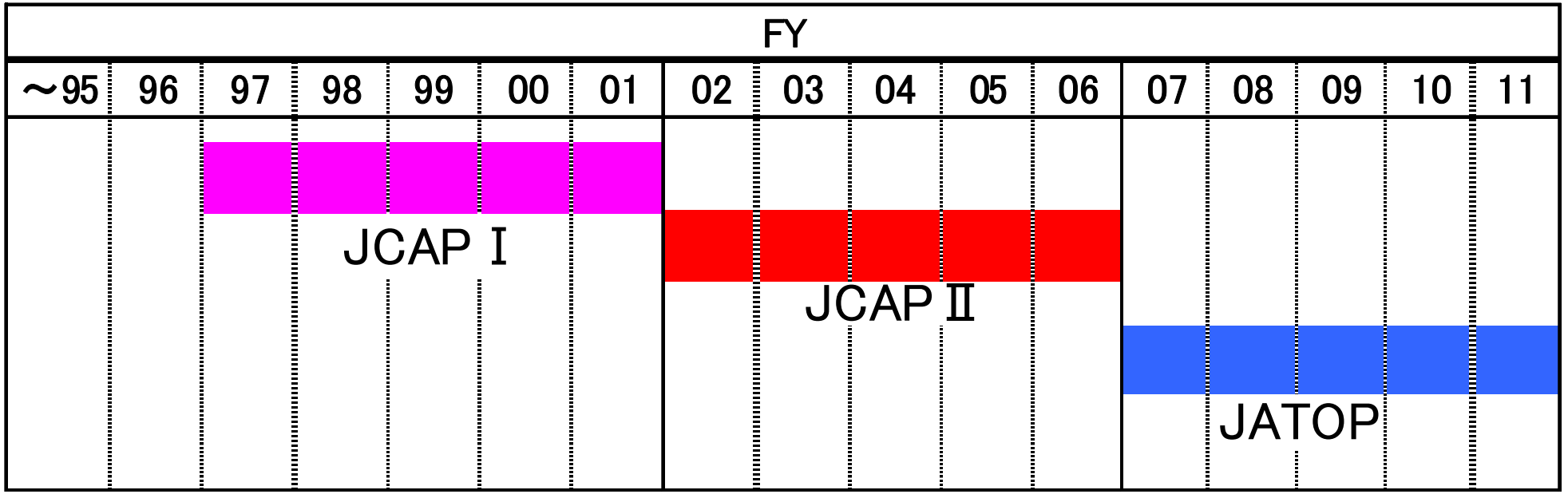
Auto-Oil Program in Japan



JCAP:Japan Clean Air Program

- JCAP Ⅰ : FY 1997 to 2001
- JCAP II: FY 2002 to 2006

JATOP:Japan Auto-Oil Program

- Started from FY2007

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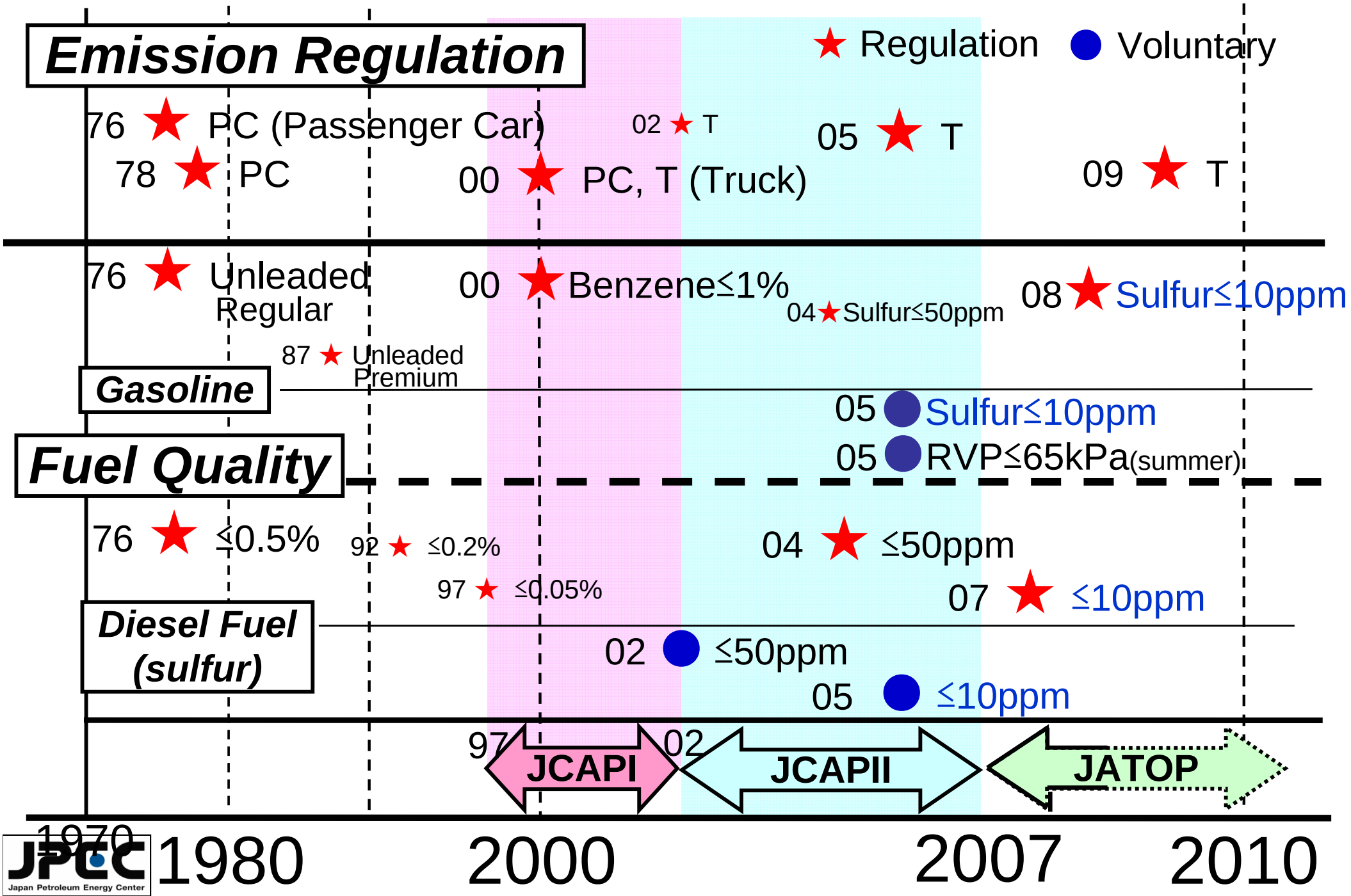
Emission & Fuel Regulation in Japan



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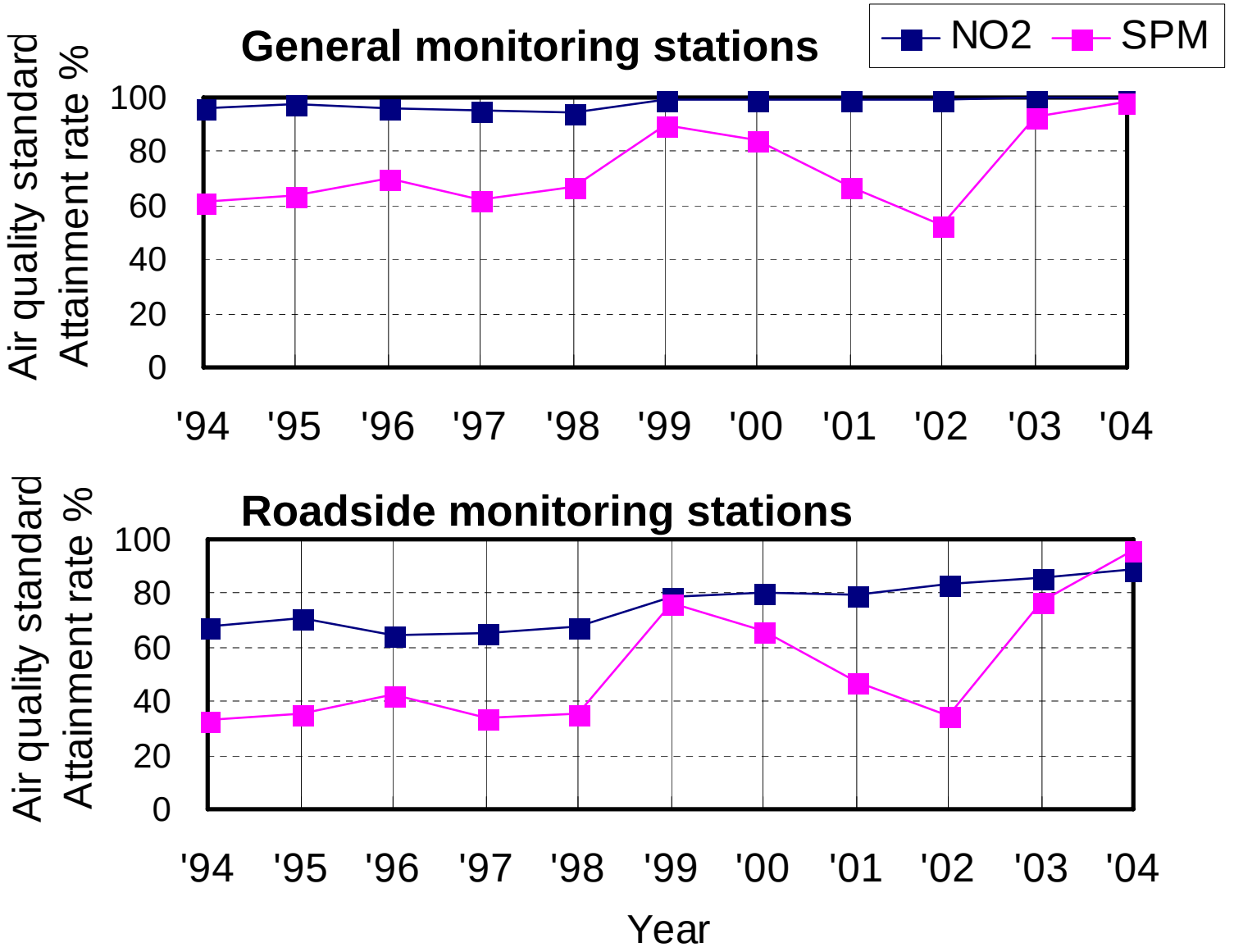
Recent situation of air quality in Japan



- Significant reduction in SPM is shown

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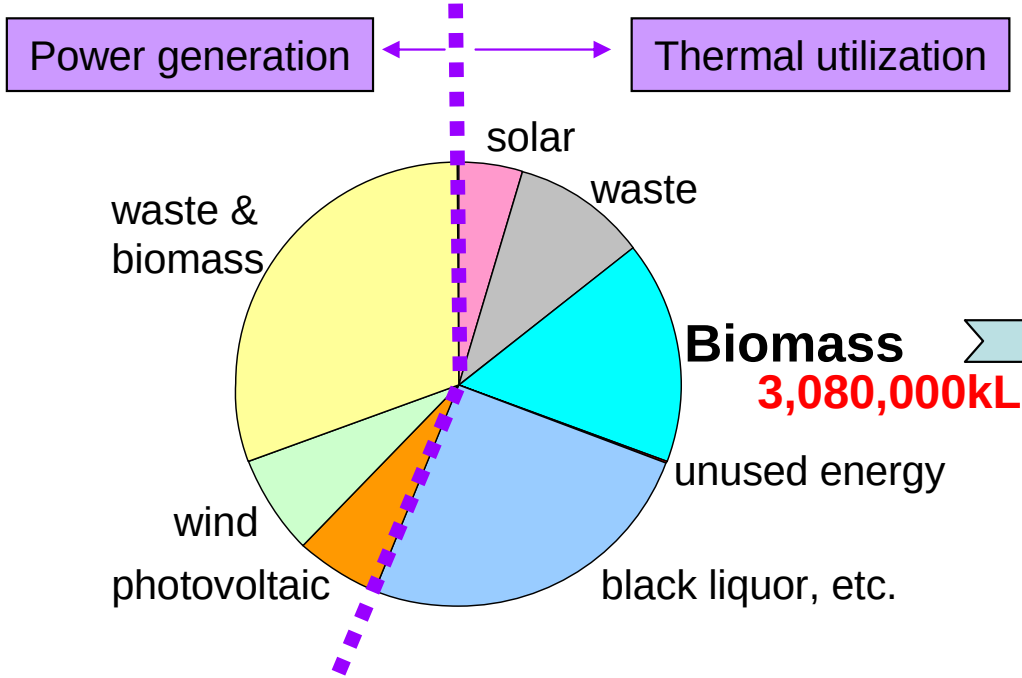
Biofuel Introduction Plan in Japan



Biomass
3,080,000kL

New Energy Supply 19,100,000kL@2010

Biofuel in transport fuel
500,000kL
(as crude oil equivalent)

ETBE in oil industry
210,000kL*
(as crude oil equivalent)

***Actual ETBE caloric equivalent would be 840,000kL.**

Issues to overcome to introduce biofuel in Japan

- **Securing of biofuel**
- **Issues regarding distribution, verification of safety**
- **Infrastructures and taxation system**

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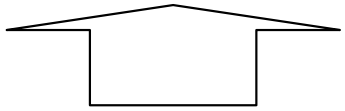
Source: METI

Standard Specification of **FAME Blended Diesel Fuel**

Items	Level
Sulfur	0.001 mass% max
Cetane Index	45 min
Distillation T90	360 deg.C max
Trigriceride	0.01 mass% max
FAME content	5 mass% max
Methanol	0.01 mass% max
Total Acid Number	0.13 mgKOH/g max
Individual Org. Acid*3	0.003 mass% max
TAN Increase	0.12 max



Compulsory Specifications

Items	Level
Flash Point	45 deg.C min
Pour Point	*1
CFPP	*2
10% Carbon residue	0.1 mass% max

*1 No.1:-2.5 deg.C max, No.2:-7.5 deg.C max, etc.
*2 No.1:-1 deg.C max, No.2:-5 deg.C max, etc.
*3 Total of Formic, Acetic and Propionic acid

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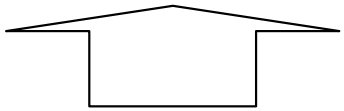
Source: Quality Control Law, JIS K2204

Standard Specification of **Gasoline**

Items	Level
Lead	No detection
Sulfur	0.001 mass% max
MTBE	7 vol% max
Oxygen content	1.3 mass% max
Benzene	1 vol% max
Kerosene	4 vol% max
Methanol	No detection
Ethanol	3 vol% max
Existent gum	5 mg/100ml max
Color	Orange



Compulsory Specifications

Items		Level
Octane number		Premium 96.0 min
		Regular 89.0 min
Density		0.783 g/cm3 max
Distillation	T10	70 deg.C max
	T50	75 to 110 deg.C
	T90	180 deg.C max
	EP	220 deg.C max
	Res.	2 vol% max
Copper corrosion		1 max
Vapor pressure		44 kPa to 78kPa*1
Oxidation stability		240 min min

*1 winter:93 kPa max, summer:65 kPa max

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Source: Quality Control Law, JIS K2202

Specific Activities toward Introduction

Oil industry's plan for introduction of ETBE

2007	50 Service Stations	Implement test sales as part of Government aid projects (distribution verification projects)
2008	approx. 100 SSs	
2009	approx. 1,000 SSs	
2010	Nationwide marketing	

Brand name: Bio-Gasoline

- ETBE: 840,000 kL (360,000 kL as ethanol content)
- Importing of ETBE is expected for quite some time

Specific Activities toward Introduction

- Why the use of ETBE ?
  - Blending as a blend stock for gasoline is possible at the refinery, meaning quality can be maintained easily
  - Reid vapor pressure (RVP) dose not rise, therefore, less environmental effect in the atmosphere
  - The current gasoline distribution facility and infrastructure can be used as it

- Oil Industry's response to introduce ETBE
  - Establishment of the Japan Biofuels Supply Limited Liability Partnership (JBSL) (Jan. 2007)
  - Import of ETBE, blended with gasoline (7% max), started distribution to designated service stations (Apr. 2007)

The Next-Generation Automobile Fuel Initiative

- Achieving energy security, environment preservation, and enhancement of competitiveness at the same time -

May 2007

Strategy for Automobile Fuel in Japan

Target in 2030:

(1) Oil dependence in the transport sector is 80%

(2) Realization of the world's most friendly automobile society based on technology innovation

Technology Innovation of Engines, Fuels and Infrastructures with 5 Strategies

Engine innovation

- **Strategy 1: Adoption of Next-Generation Batteries**
  - Battery project for next-generation automobiles
- **Strategy 2: Fuel Cells and Hydrogen Society**
  - Development of fuel cells that form the key to "a hydrogen society, which is transition from the carbon cycle to the water cycle.

Fuel innovation

- **Strategy 3: Clean Diesel**
  - Refurbished image of fuel-efficient and clean engine
- **Strategy 4: Biofuels**
  - **"Worry-free, safe and fair" expansion and the second-generation bio-fuel**

Infrastructure innovation

- **Strategy 5: World's most friendly automobile society initiative**
  - Creation of the World's most friendly automobile society, capitalizing on IT

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Source: METI

A Next-Generation Automobile Fuel Initiative

- **Strategy 4: Biofuels**

“Worry-free, safe and fair” Expansion and the second-generation biofuel.

  - Setting up **“the Bio Fuel Technology Innovation Council”**. (The industrial academic and government sectors cooperate with each other to accelerate the development of next generation biotechnology)
  - Aiming at the advent of next-generation domestic bio fuel, **cellulosic ethanol**, of 100 yen per liter in 2015 (Biomass Nippon). Then, further aiming at bio fuel of 40 yen per liter (technology innovation case).
  - Establishment of systems and infrastructures to secure quality and prevent tax evasion.

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Source: METI

JATOP

JATOP(Japan Auto-Oil Program)

(1) Start of JATOP
- Following JCAP Ⅱ ended in FY 2006, JATOP has started in FY 2007

(2) Research Overview
- Use of new fuels (biomass fuels, synthetic fuels, etc. for responding to fuel diversification)
- CO2 emissions reduction (diesel technology, etc.)
- Improvements to Air Quality Model and its application

(3) Expectations to JATOP
- Contribution to the steady introduction of biofuels
- Contribution to CO2 emissions reduction

Contents of JATOP

- Research for fuel diversification
  - Study on use of high concentration biodiesel blends
  - Study on use of biofuel-blended gasoline
  - Quality study on fuels including unconventional petroleum fuel to be available in the future
- Research for improved efficiency and reduced CO2 emissions
  - Evaluation of potential of diesel vehicles
  - Basic study on new indicators of anti-knock quality and ignitability compatible with new combustion technologies
- Air quality improvement study

JATOP
Study on use of high concentration biodiesel blends

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Japan's Mandatory Standard for Diesel Fuels

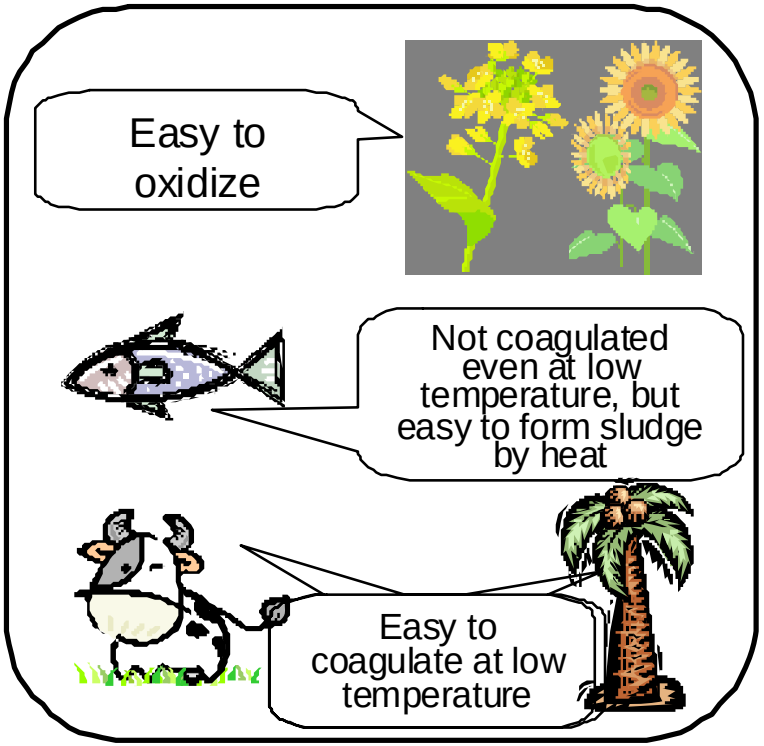
Regulatory Item		Standard Limits for Diesel Fuel	
		Conventional diesel fuel	FAME blend with conventional diesel fuel
Sulfur content	Existing item	0.01 mass% max.	←
Cetane index	Existing item	45 min.	←
T90	Existing item	360°C max.	←
FAME blend level	New item	0.1 mass% max.	5.0 mass% max.
Triglyceride content	New item	0.01 mass% max.	←
Oxidative stability (Increase in acid number)	New item	No inspection required	0.12 mgKOH/g max.
Acid number	New item	No inspection required	0.13 mgKOH/g max.
Formic acid, Acetic acid, Propionic acid	New item	No inspection required	0.003 mass% max. in total
Methanol content	New item	No inspection required	0.01 mass% max.

2007This standard is promulgated on Jan.15, 2007, and enforced starting on March 31, 2007.

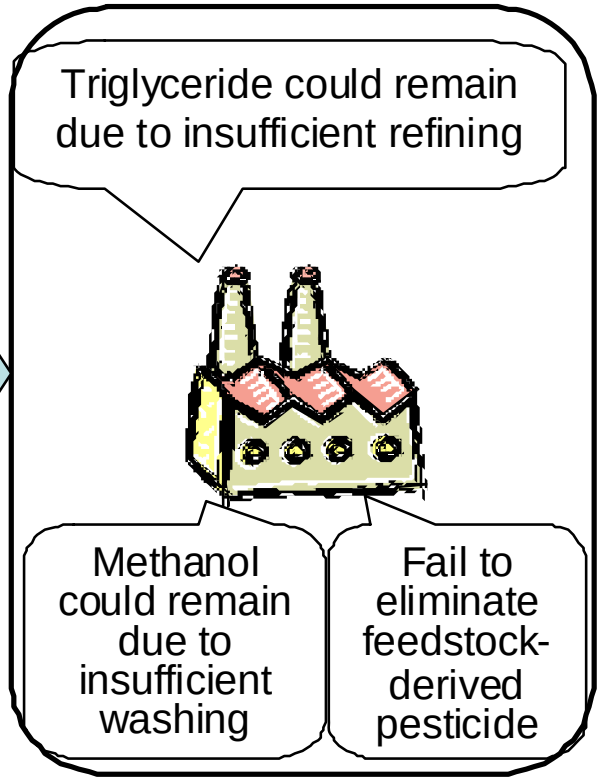
Concern about Biodiesel Blend

Concern is being raised about impact on fuel quality and vehicle design/ performance because of the differences in feedstock types (chemical composition) and refining processes (impurities contained).

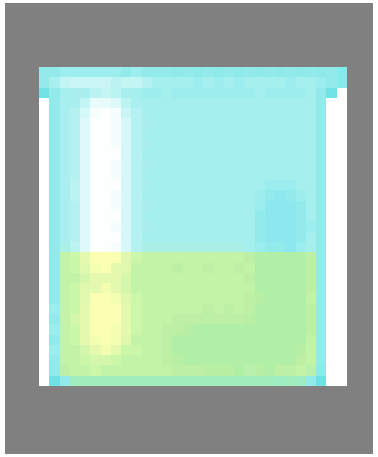
Differences in feedstock types



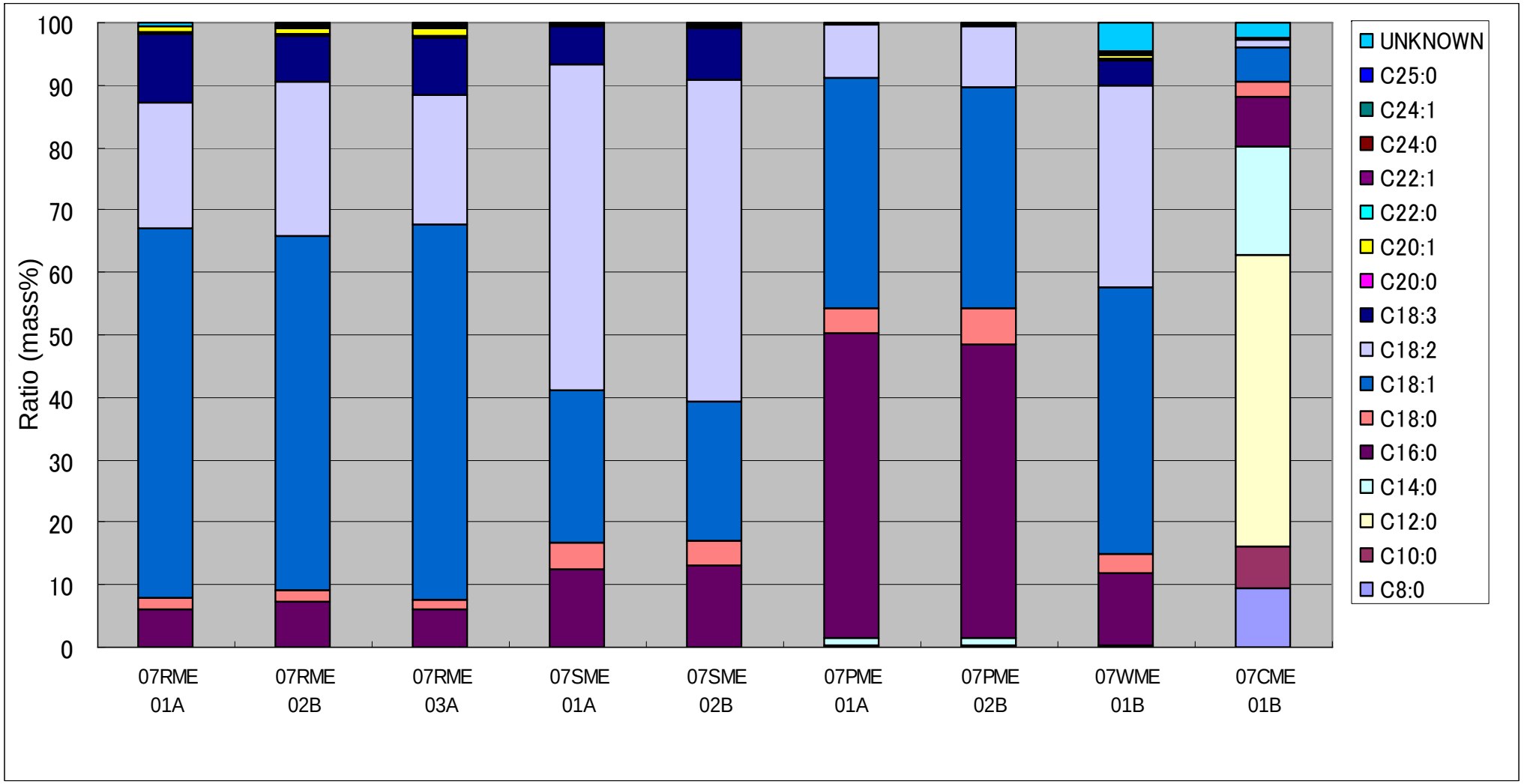
Difference in refining



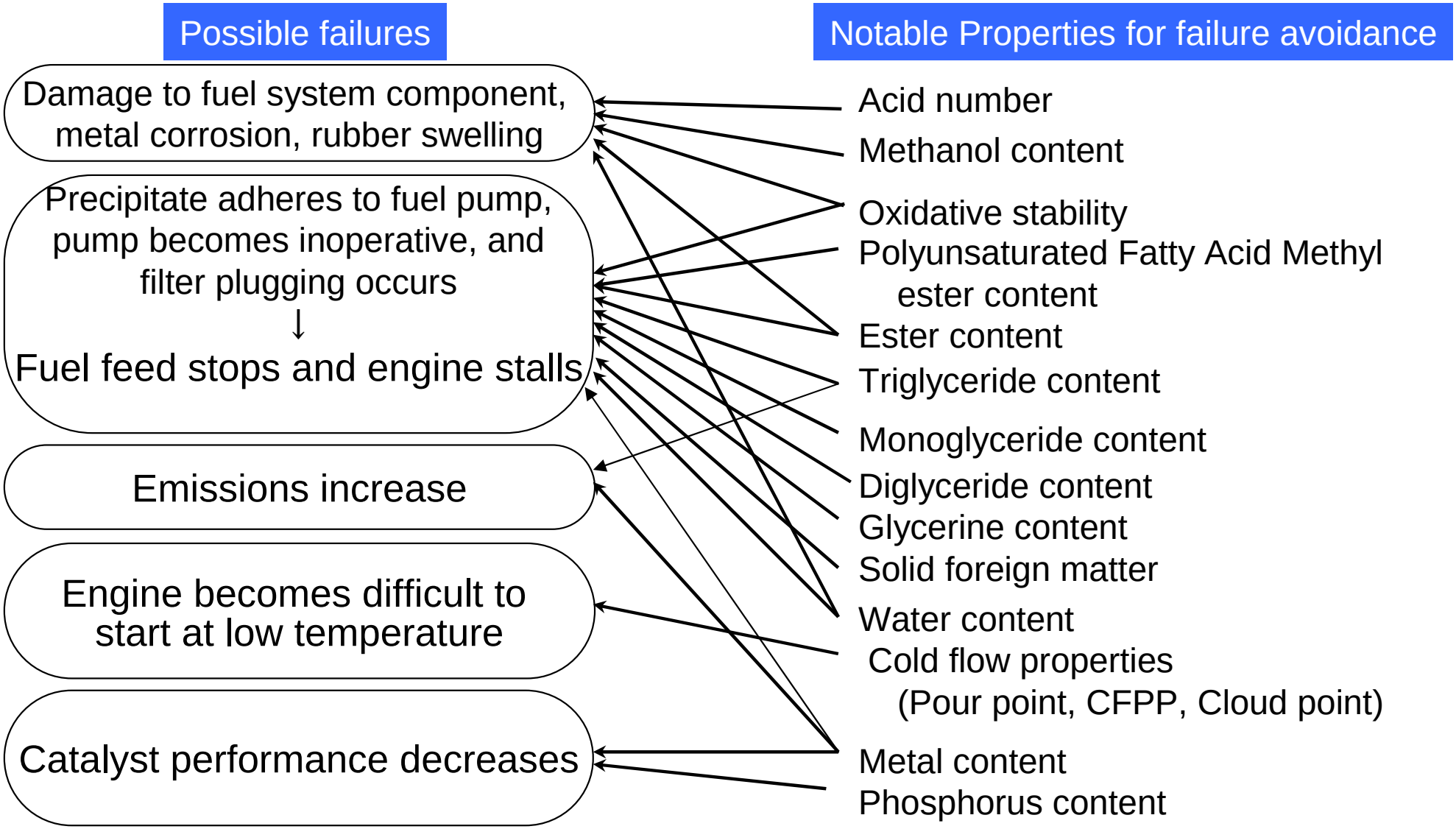
Is there impact on biodiesel blend?



(1) General Properties (FAME composition)



Notable Properties of Biodiesel Blended Fuel for Application Technology Study



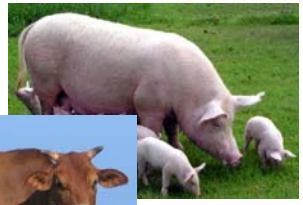
New Forms of Biodiesel Fuels

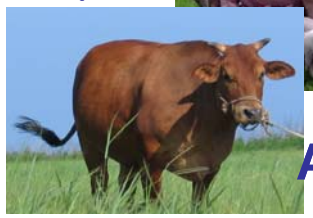
Rape blossoms

Palm

Soy bean

Fat/Oil





Animals

Direct blending

Methanol → FAME

Bioethanol → FAEE

Hydrogenation → BHD

Plant

Gasification FT synthesis → BTL

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Study on use of high concentration biodiesel blends

Objectives

- Identify technological issues on the use of high biodiesel blends (over 5%) in diesel vehicles,
- Conduct an analytical study on the issues to develop measures to be taken by fuel producers and vehicle manufacturers, and
- Produce new technological findings that could contribute to the study of introduction of high biodiesel blends in Japan, including establishment of a national fuel quality standard covering high biodiesel blends.

Research Policy

Target biomass feedstock

Major FAMEs available in the market: Palm oil ME, Rape oil ME, Soy oil ME

Next generation biofuel (Hydrocarbon fuel): BHD, FT diesel (BTL)

Differences in structure between first generation biofuels and major FAMEs: Waste cooking oil ME, Coconut oil ME and Palm oil were also evaluated in some research themes.

FY '07 research conducted using GTL

Target biodiesel blend level

Main target level: 10 and 20%

In the case that no tendency was observed with 10 and 20% blends, higher biodiesel blends (50% blend and neat biodiesel) were planned to be tested.

Research Theme

A broad evaluation of the Impact on vehicle technology and fuel quality

(1) Impact on fuel properties, (2) Impact on stability, (3) Impact on emissions,
(4) Impact on exhaust aftertreatment systems, (5) Impact on cold driveability,
(6) Impact on lubricating oil

Subject of Research

(1) Impact on fuel properties

1) General properties
2) Cold flow properties
3) Ignition quality

(2) Impact on stability

1) Acid/sludge formation behavior and mechanism analysis
2) Impact on material and components of vehicle fuel systems

(3) Impact on emissions

(4) Impact on exhaust aftertreatment system

(Aftertreatment capability evaluation)

1) Balance Point Temperature
2) DPF regeneration rate
3) Soot composition analysis
4) DPF active regeneration control

(SAE 2008-01-2494)

(5) Impact on cold driveability

(6) Impact on lubricating oil

1) Laboratory test
2) Engine test

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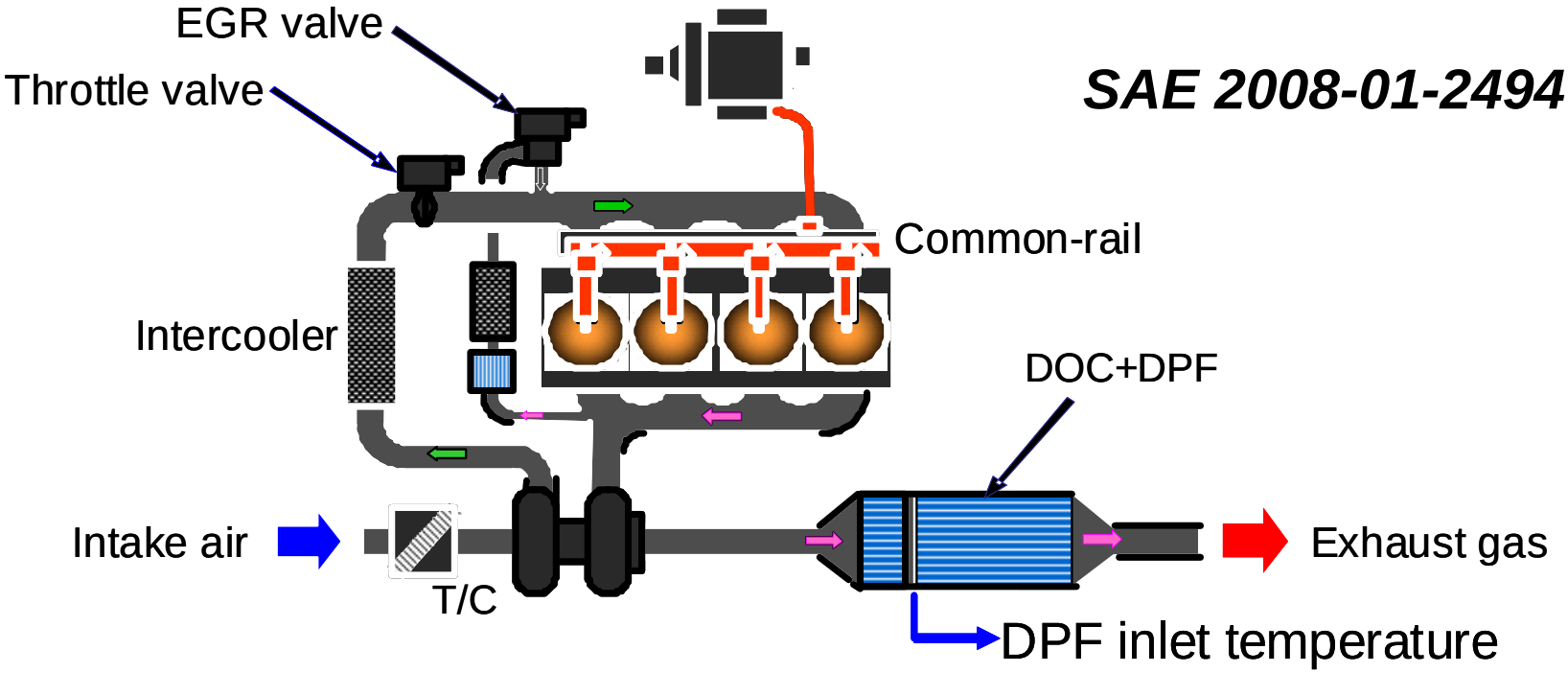
(4) Impact on Exhaust Aftertreatment Systems
< DPF performance research >

Test Engine Specifications

Number of Cylinders	4
Diplacement (L)	4.0
Emission regulation	Japan's 2005 Regulations
Advanced emissions control technology	Turbo intercooled Common-rail injection system Cooled EGR DPF with oxidation catalyst

(not always designed for high BDF blended diesel fuels)



SAE 2008-01-2494

(4) Impact on Exhaust Aftertreatment Systems
< DPF performance research >

Conclusions (compared to base diesel fuel)

Test item		BDF blend level (mass%)			
		10	20	50	100
BPT		○	○	◎ (FAME)	◎ (FAME)++
DPF regeneration rate		○	○	◎(RME) ○(SME)	
DPF active regeneration control	Automatic	○	○	○(FAME)	×(FAME)
	Manual	○	○(HBD) ×(FAME)	× (FAME)++	× (FAME)++

◎: Impact 'smaller'
○: Impact 'equivalent'
×: Impact 'larger'
++: estimated from the results of other blends

SAE 2008-01-2494

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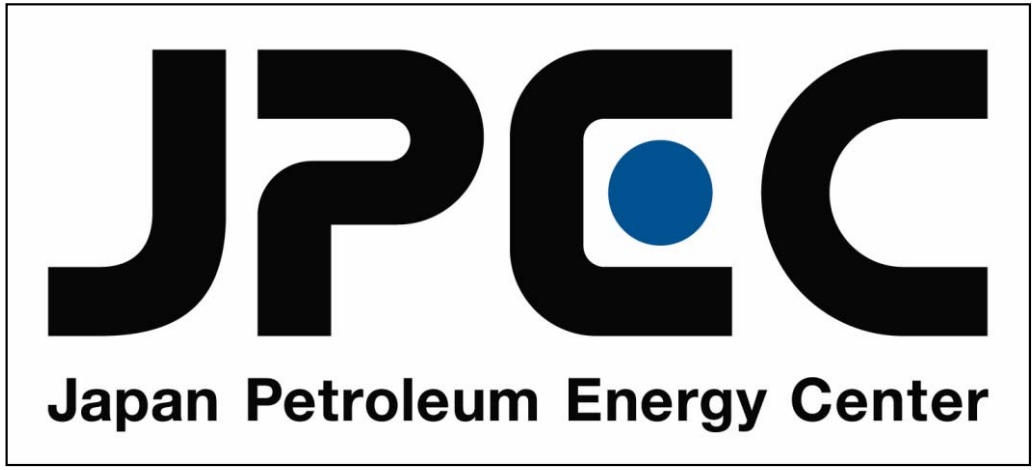
Thank for your attention.



http://www.pecj.or.jp/english/index_e.html