

4 Dec, 2024

# Control measures of VOCs: Case study of Saitama Prefecture of Japan

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# Topics

1. Current status of O<sub>3</sub> pollution in Saitama
2. Regulation of VOCs by law and voluntary action to reduce VOCs in companies
3. VOC emissions and concentration trend
4. VOC emission control
5. TVOC measuring instruments and case studies at small-medium sized factories

# Introduction of CESS

Center for Environmental Science  
in Saitama (CESS)



## Four Basic Functions:

1. Environmental Research
2. International Cooperation
3. Dissemination of environmental Information
4. Environmental Education

CESS was established as a multi-functional comprehensive core institute for environmental science in Saitama prefecture in 2000.

Global warming countermeasure

Atmospheric environment

Natural environment

Material cycles and waste management

Chemical substances and environment radioactivities

Water environment

Environmental geotechnology

Biodiversity



# Overview of CESS

Air pollution  
monitoring room

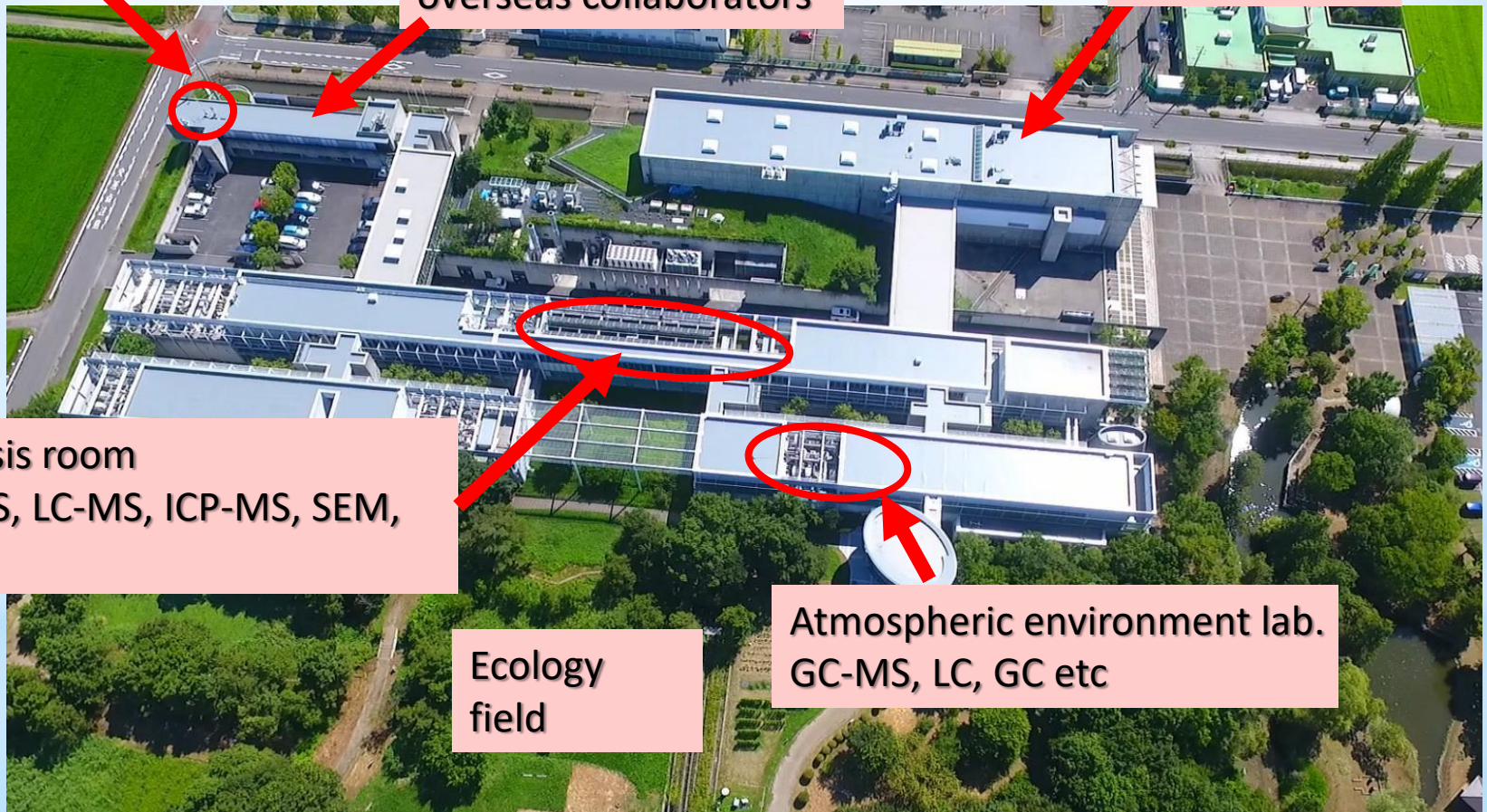
Guest rooms for  
overseas collaborators

Exhibition hall

Analysis room  
GC-MS, LC-MS, ICP-MS, SEM,  
IR

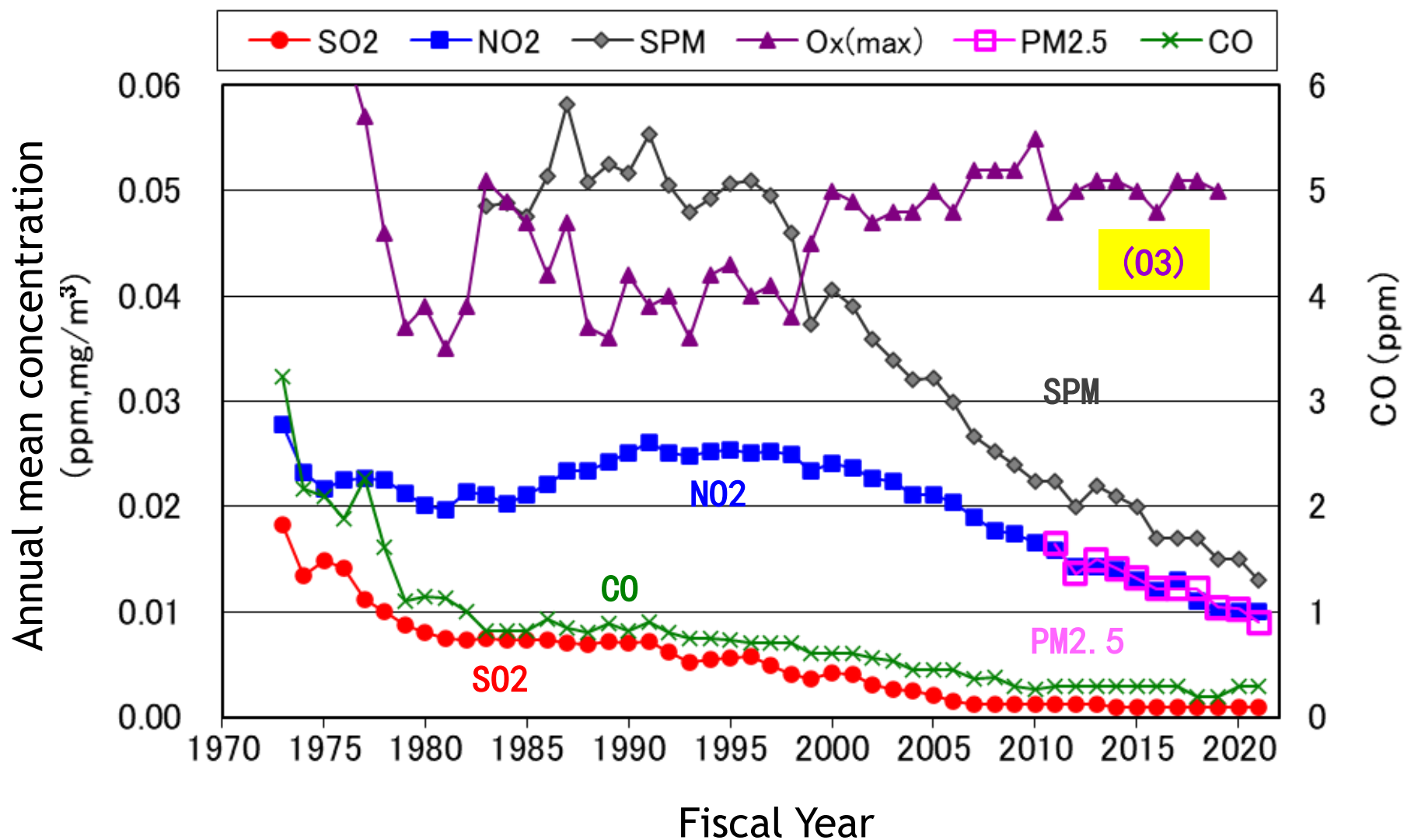
Atmospheric environment lab.  
GC-MS, LC, GC etc

Ecology  
field

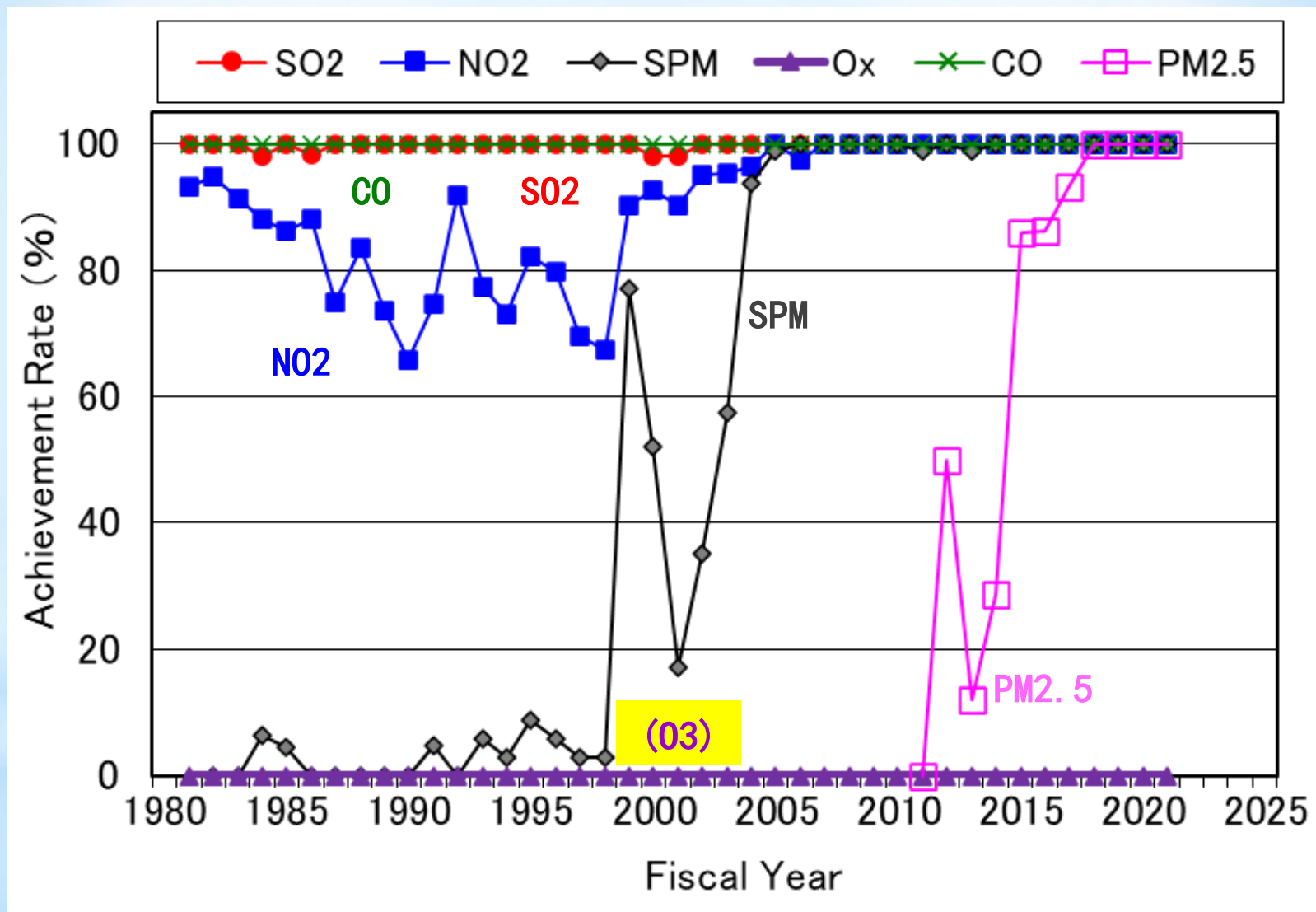


# 1. Current status of O<sub>3</sub> pollution in Saitama

The annual mean concentration of air pollutants in Saitama pref.



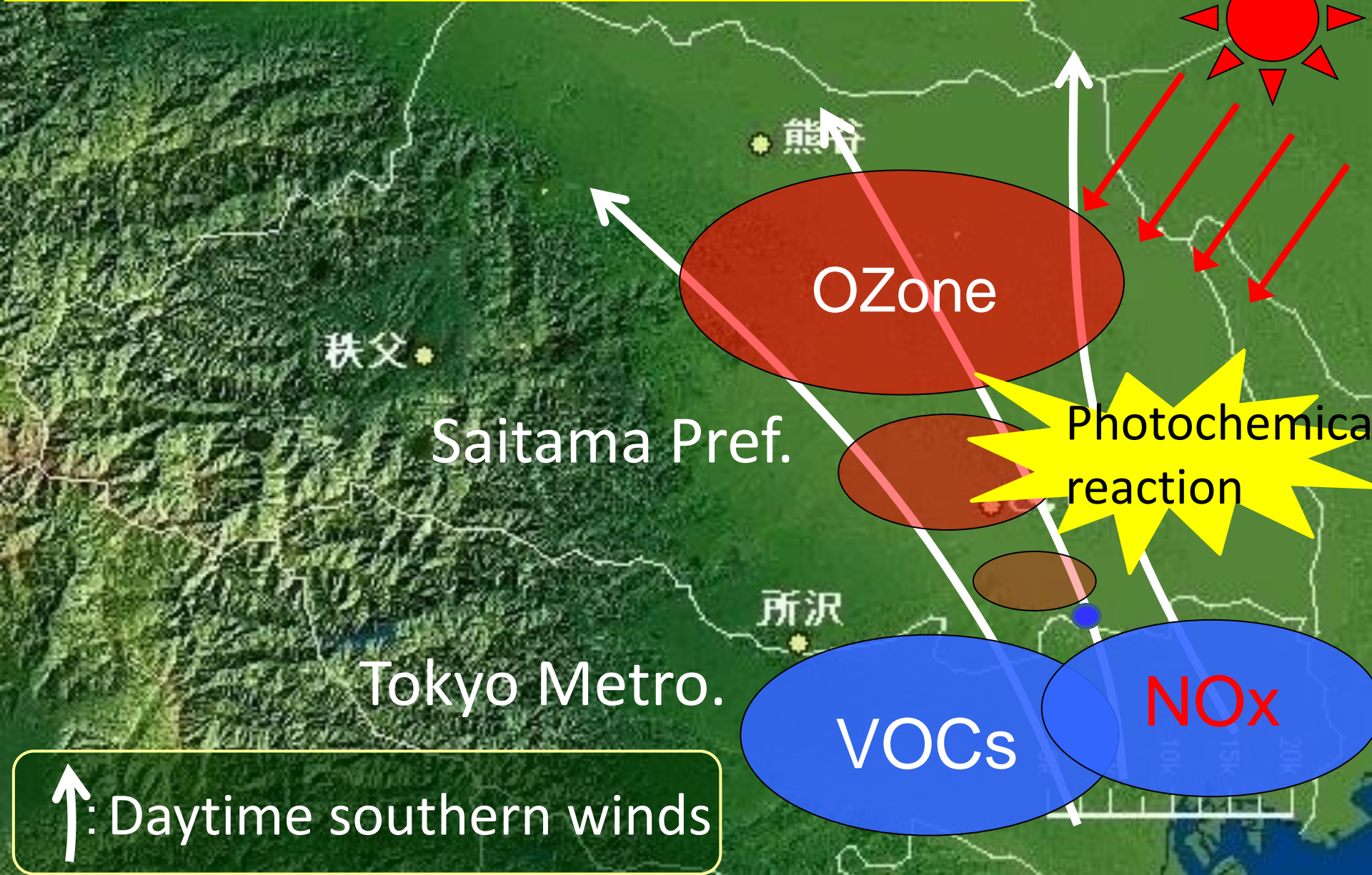
# The achievement rate of air quality standard in Saitama pref.



# Ranking of the number of days for which a photochemical smog alert was issued

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
Saitama	Saitama	Chiba	Tokyo	Saitama	Saitama	Osaka, Okayama	Saitama, Chiba	Okayama	Saitama, Chiba	Saitama	Tokyo, Kanagawa	Saitama	Saitama	1st
Tokyo	Chiba, Tochigi	Saitama	Kanagawa	Chiba	Chiba			Saitama		Tokyo		Tokyo, Chiba	Chiba	2nd
Tochigi		Kanagawa Okayama	Chiba	Gunma	Tokyo	Kanagawa Hiroshima	Gunma	Chiba, Tokyo	Tokyo	Chiba	Chiba			3rd
Chiba	Gunma		Saitama		Osaka				Kanagawa Okayama	Ibaraki, Tochigi	Yamanashi	Gunma, Kanagawa	Gunma, Tokyo, Osaka, Okayama	4th
Ibaraki	Tokyo		Okayama, Osaka	Ibaraki, Tokyo, Kanagawa	Kanagawa	Tokyo		Kanagawa			Saitama, Shizuoka			5th
Gunma Osaka	Kanagawa	Gunma, Tokyo, Osaka			Gunma, Okayama	Tochigi	Tokyo, Tochigi	Osaka	Tochigi, Osaka	Gunma, Kanagawa		Ibaraki		6th
	Osaka		Gunma	Yamanashi		Chiba Gunma		Tochigi			Ibaraki etc.	Yamanashi, Hiroshima	Tochigi	7th
25	17	7	13	13	16	1	15	10	9	7	2	8	7	Number of days

Typical high concentration pattern in summer



## 2. Regulation of VOCs by law and voluntary action to reduce VOCs in companies

April 1, 2006: VOCs emission control began (Revised Air Pollution Control Law)

### ① Regulation by law

Target: 6 facility types (Large-scale facilities)

### ② Voluntary action

Target: All facilities that produce or use VOCs

Government aimed to achieve a 30% reduction by 2010 from the base year of 2000, combining the two methods.

# ① Regulations by Law

Target: 6 large-scale facility types

- Notification of facilities
- Compliance with emission standards at outlets
- Measurement of emission concentration (at least twice a year)

6 facilities:

- (1) Drying facilities in the manufacture of chemical products
- (2) Painting facilities and drying/baking facilities after painting
- (3) Drying and baking facilities for facilities using adhesives
- (4) Drying and baking facilities after printing at printing facilities
- (5) Industrial washing facilities and drying facilities after washing
- (6) Storage facilities for VOCs

Facility type		Blower, Fan	Emission standard (ppmC/m3) *
Chemical products manufacturing	Solvent (Drying)	$\geq 3000\text{m}^3/\text{h}$	600
Painting process	Painting and spraying	$\geq 100,000\text{m}^3/\text{h}$	700 (Vehicle 400)
	Drying	$\geq 10,000\text{m}^3/\text{h}$	600 (Wood etc, 1,000)
Adhesion Process	copper laminates for circuits, adhesive sheets, release paper, packaging material manufacturing, and bonding (Drying)	$\geq 5,000\text{m}^3/\text{h}$	1,400
	Others	$\geq 15,000\text{m}^3/\text{h}$	1,400
Printing process	Offset printing (Drying)	$\geq 7,000\text{m}^3/\text{h}$	400
	Photogravure (Drying)	$\geq 7,000\text{m}^3/\text{h}$	700
Cleaning process	For industries (Cleaning, Drying)	Air contact surface $\geq 5\text{m}^3$	400
Storage※	Gasoline, crude oil, naphtha, etc.	Volume $\geq 1,000\text{kL}$	60,000

## ② Voluntary efforts to reduce VOCs in companies

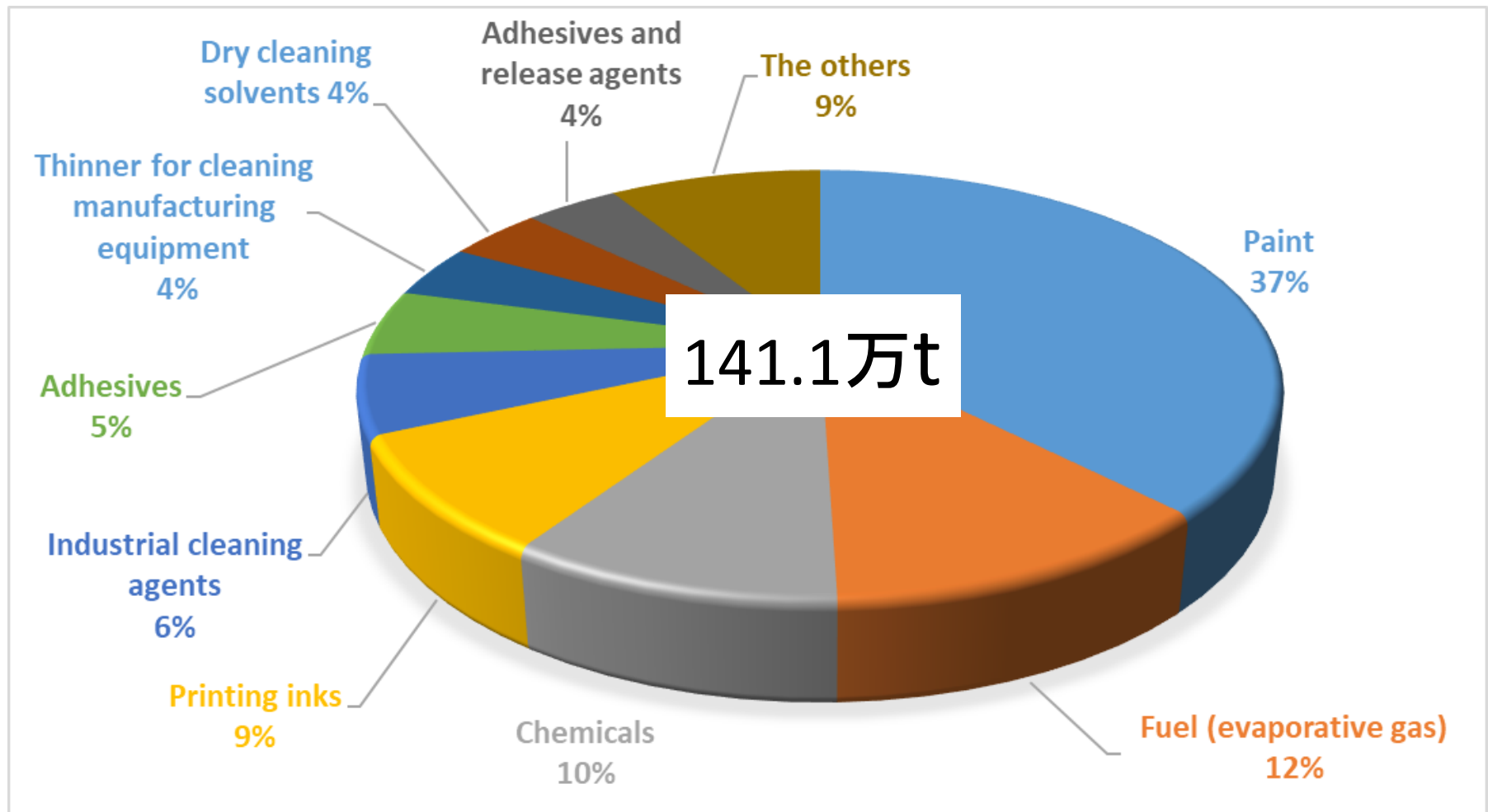
All facility types, all facility sizes

- Small and medium-sized facilities not subject to regulation
- Facility types not subject to regulation
- Parts of emission vents
- Volatilization and emission of VOCs from outside the facility, such as outdoor painting work

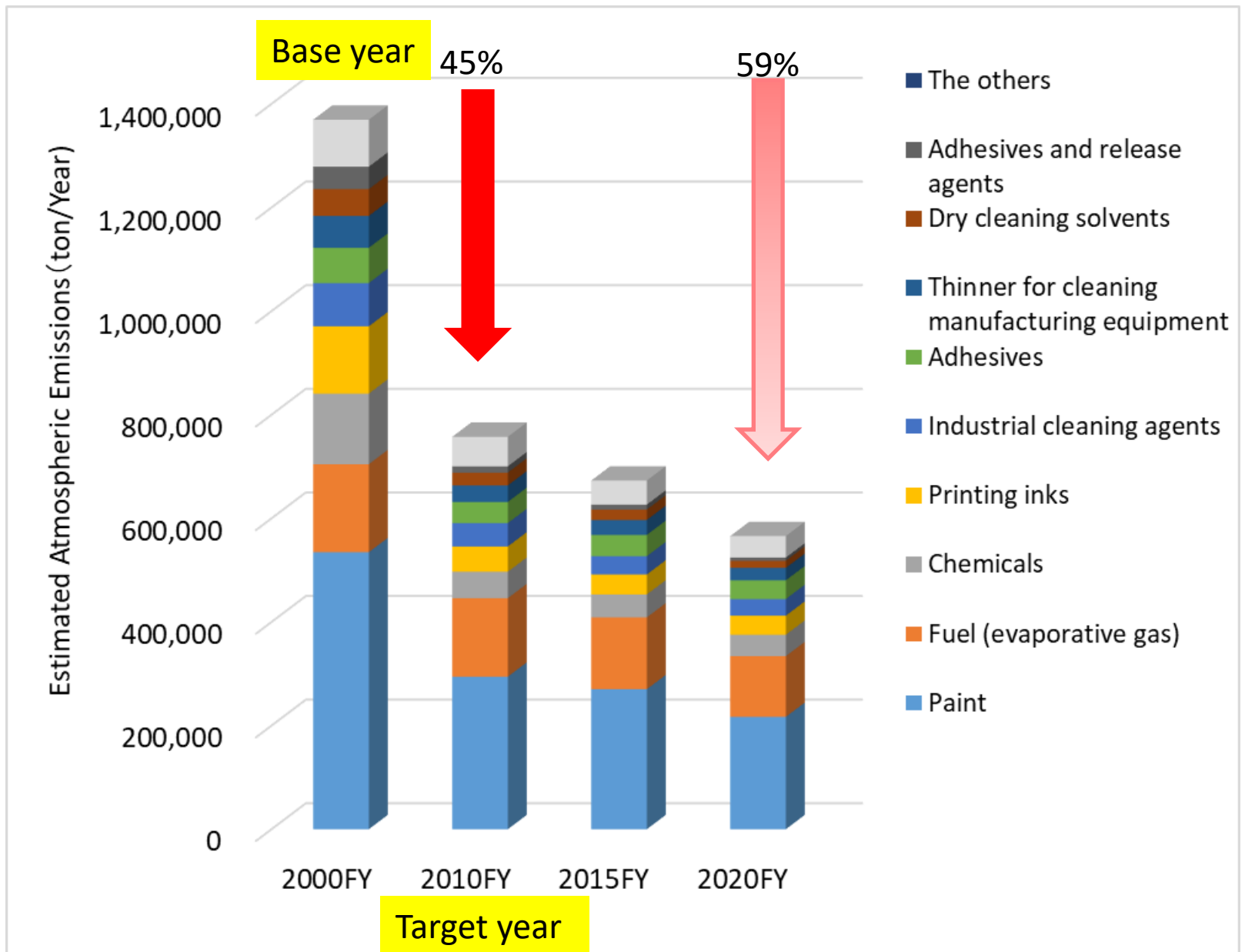


VOC Control Support Project by Atmospheric Environment Division in Saitama prefectural government.

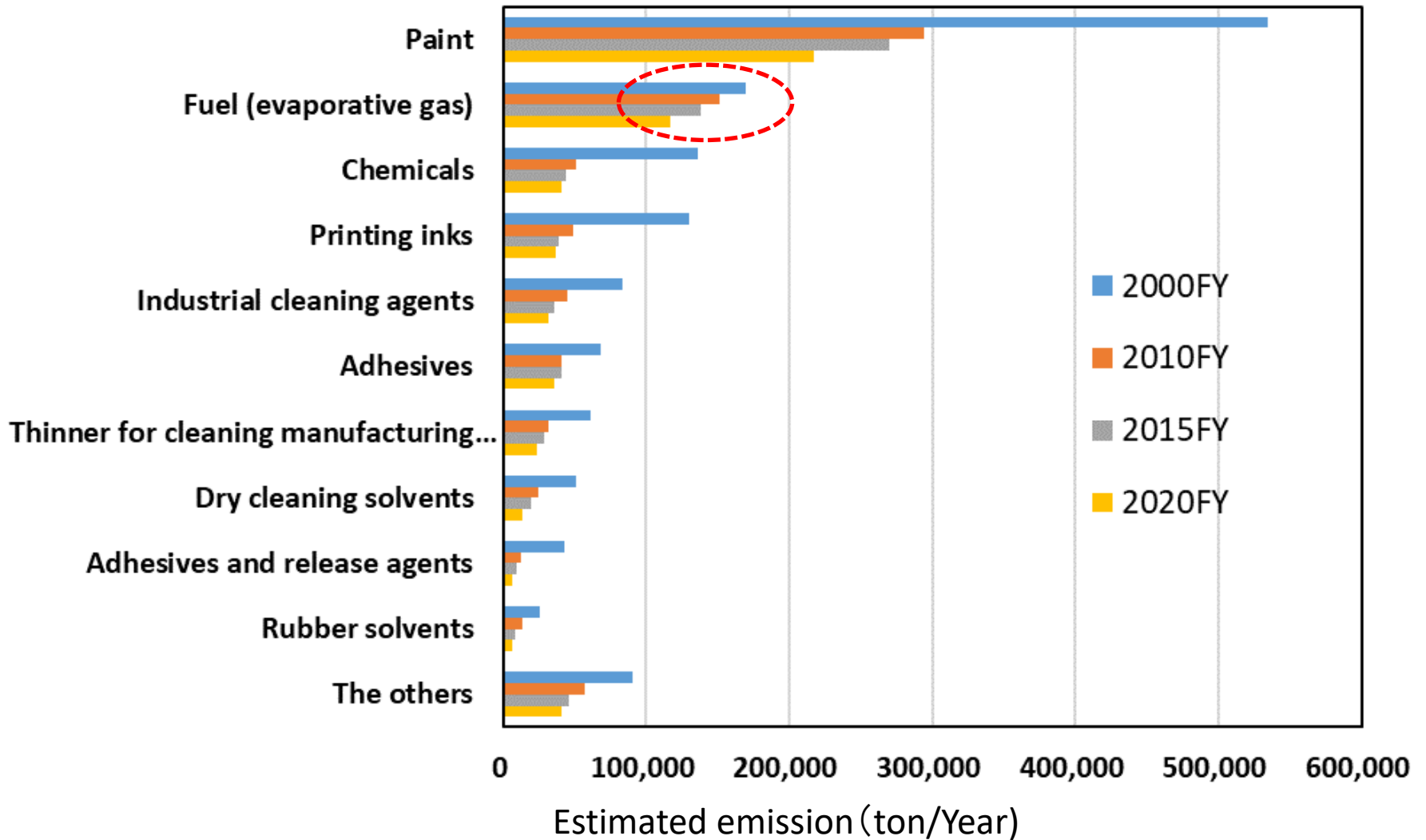
### 3. VOC emissions and concentration trend



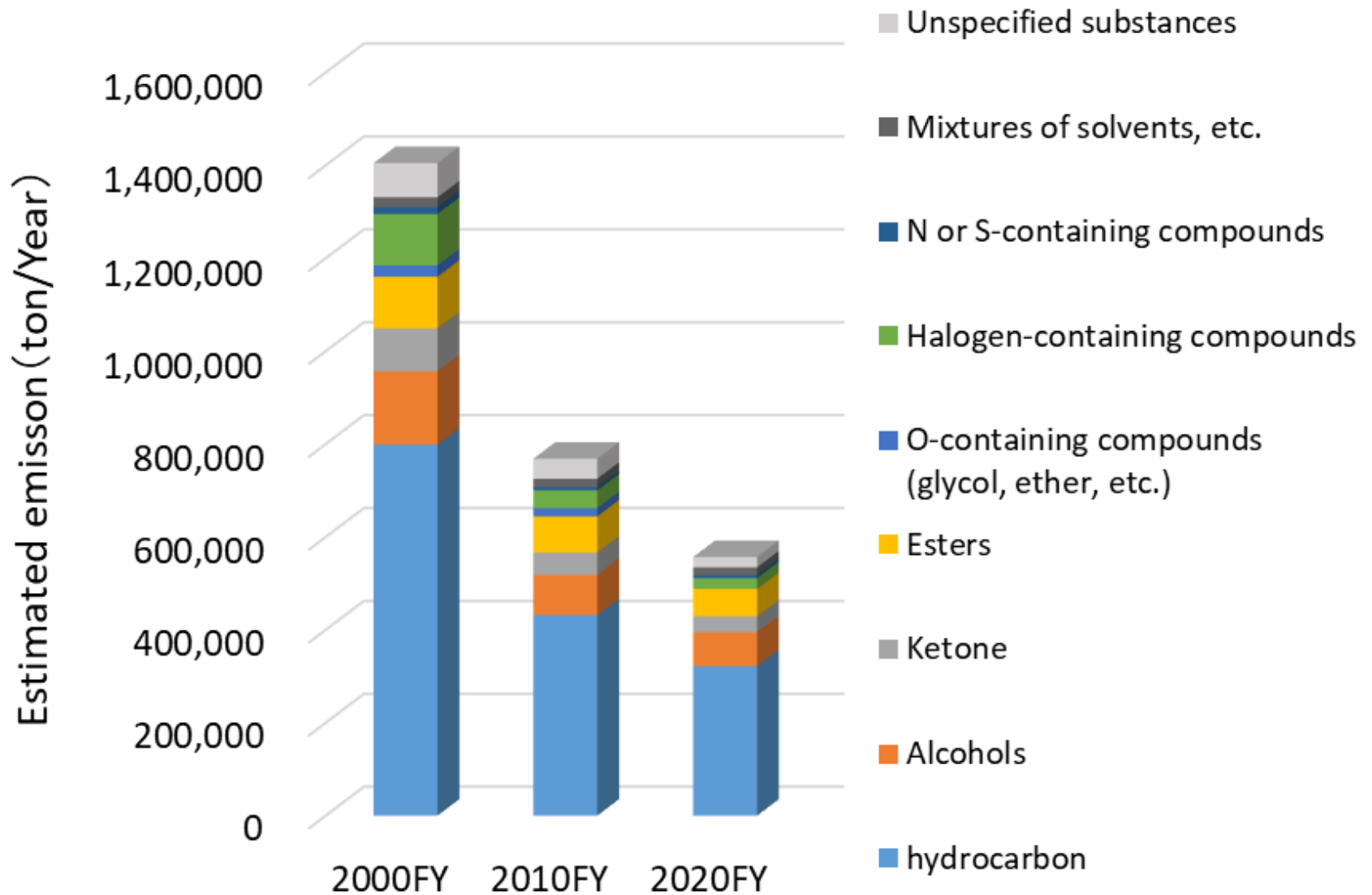
VOC emission sources (Ministry of the environment, 2000)



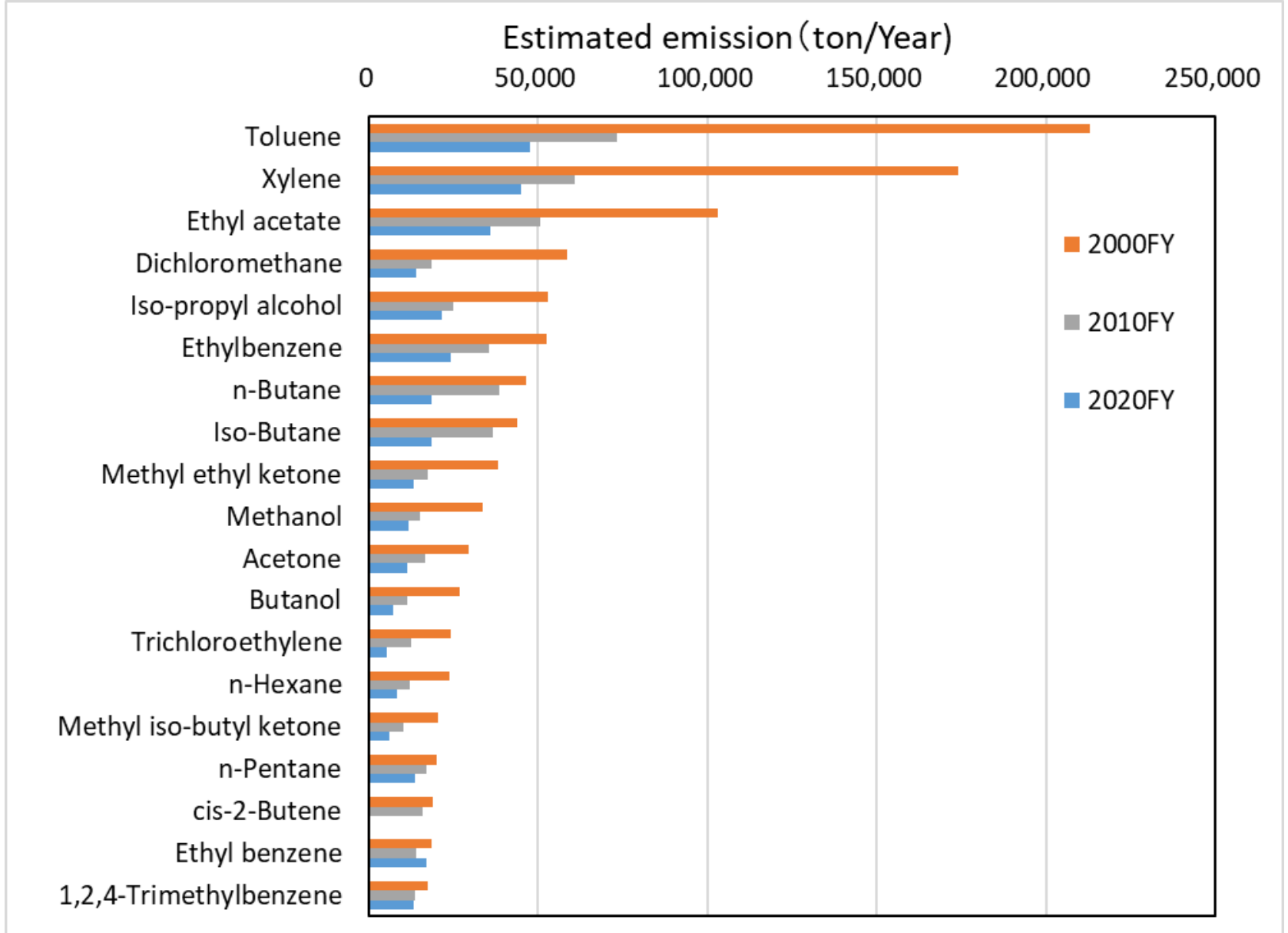
VOC emissions by application (Ministry of the Environment)



VOCs emissions by its application (Ministry of the Environment)



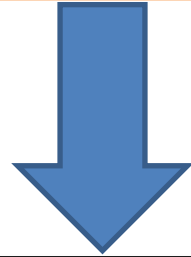
Emissions of VOCs by substance (Ministry of the Environment)



VOCs (individual components) emissions  
 Top 20 emitters are listed.

## 4. VOC emission control

Reduce the amount of VOCs handled



- Decrease in the amount of VOCs products handled
- Use of low-VOCs products

Painting, cleaning, gluing, printing, etc.  
Facilities that emit VOCs

### In plant measure

Reduction of VOCs volatilization

- Number and area of VOCs generated
- Lids, openings, enclosures
- Cooling
- Recovery

- Training of employee skills
- Improvement of painting techniques (Paint reduction)
- improvement of working procedures

### End of pipe measure

VOCs from the outlets

- Prevent atmospheric release of VOCs
- Adsorption and combustion equipment
- Local exhaust equipment

# VOCs Emission Control Technology

## 1. Conversion to low-VOCs products

- (1) Paints: Water-based paints, solvent-free paints, high-solids paints
- (2) Inks: Water-based inks, solvent-free inks
- (3) Adhesives: Water-based adhesives, hot melt adhesives, reactive adhesives, pressure-sensitive adhesives

## 2. Improvement of facility structure, management, etc.

- (1) Installation of painting and bonding booths: dry booths (small for painted areas), wet booths (large for painted areas)
- (2) Installation of air seals in drying ovens
- (3) Change to precoat coating
- (4) Securing freeboard ratio (\*) and cooling of cleaning agent  
(\* ) Height/opening dimension from air boundary to top of cleaning layer (short)
- (5) Installation of vapor return device
- (6) Change to floating roof-type tank

## 3. Installation of VOCs treatment equipment - collection and decomposition equipment

- (1) Adsorption method
- (2) Cooling and condensation method
- (3) Direct combustion method
- (4) Catalytic combustion method
- (5) Thermal storage combustion method

## 5. TVOC measuring instruments and case studies in small-medium sized companies

### NDIR method

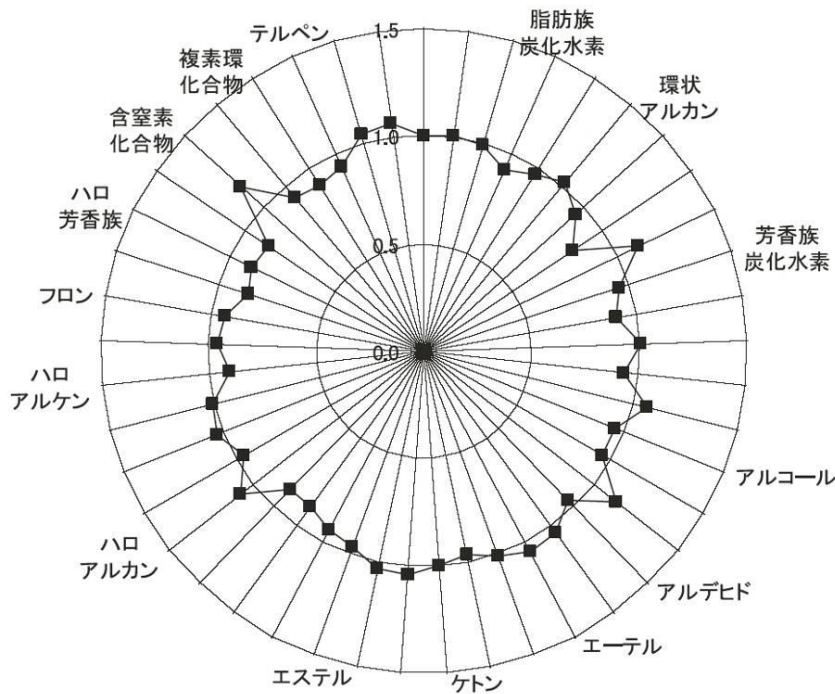


### FID method

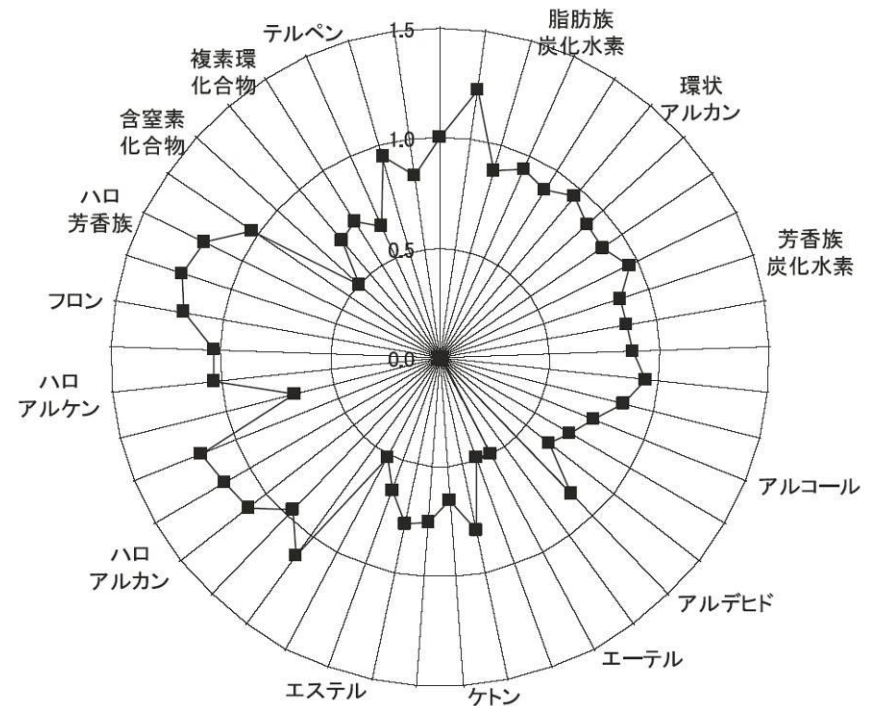


# Comparison of sensitivity

## NDIR detector



## FID detector



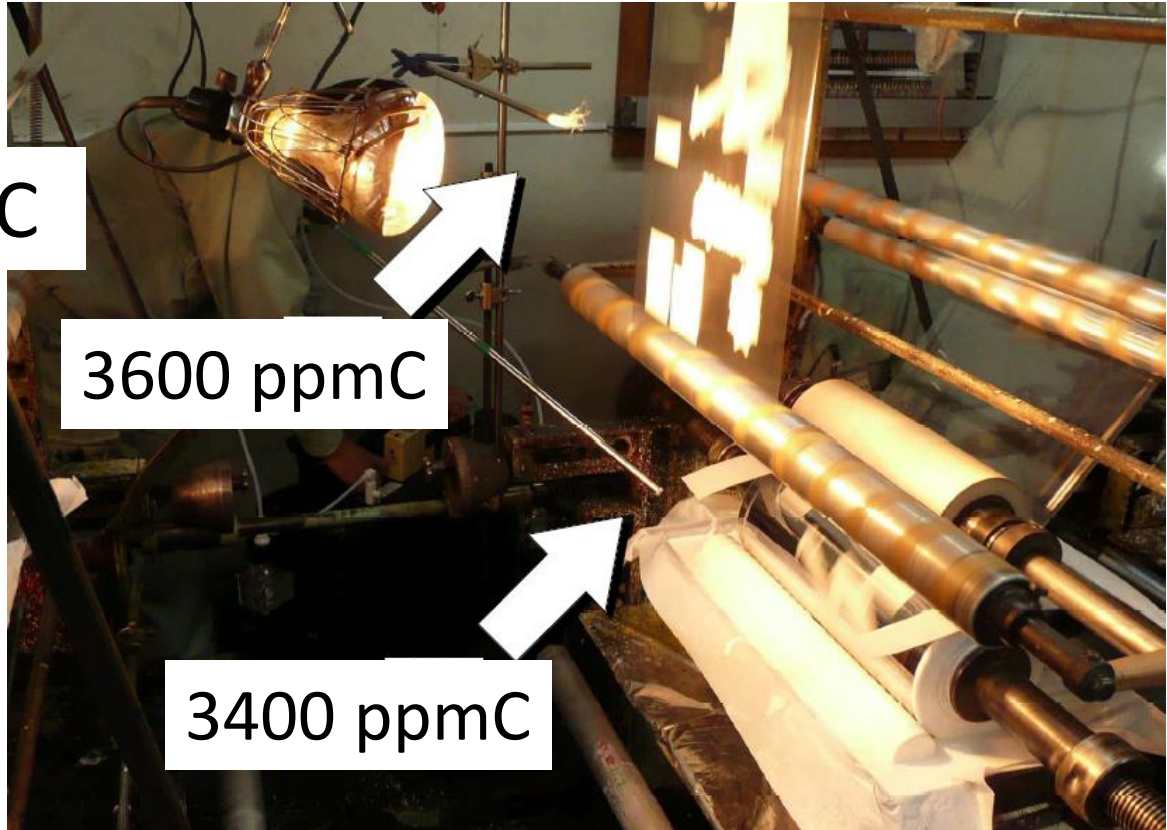
NDIR is relatively well-balanced, while FID is less sensitive to some compounds, including Acids and Halogens. Therefore, depending on the object to be measured, the two methods may give different measurement results.

# VOC reduction support project for small factories by Saitama prefectural government.



6600 ppmC

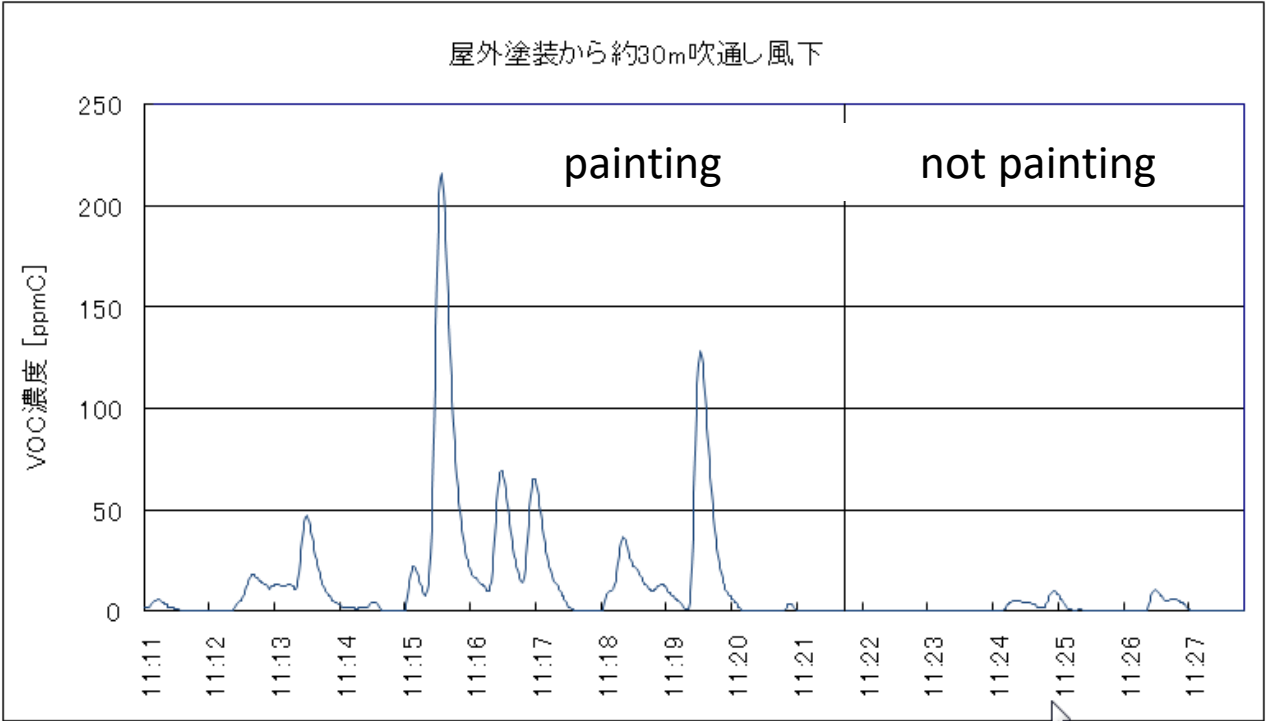
NDIR-type VOC meter was used



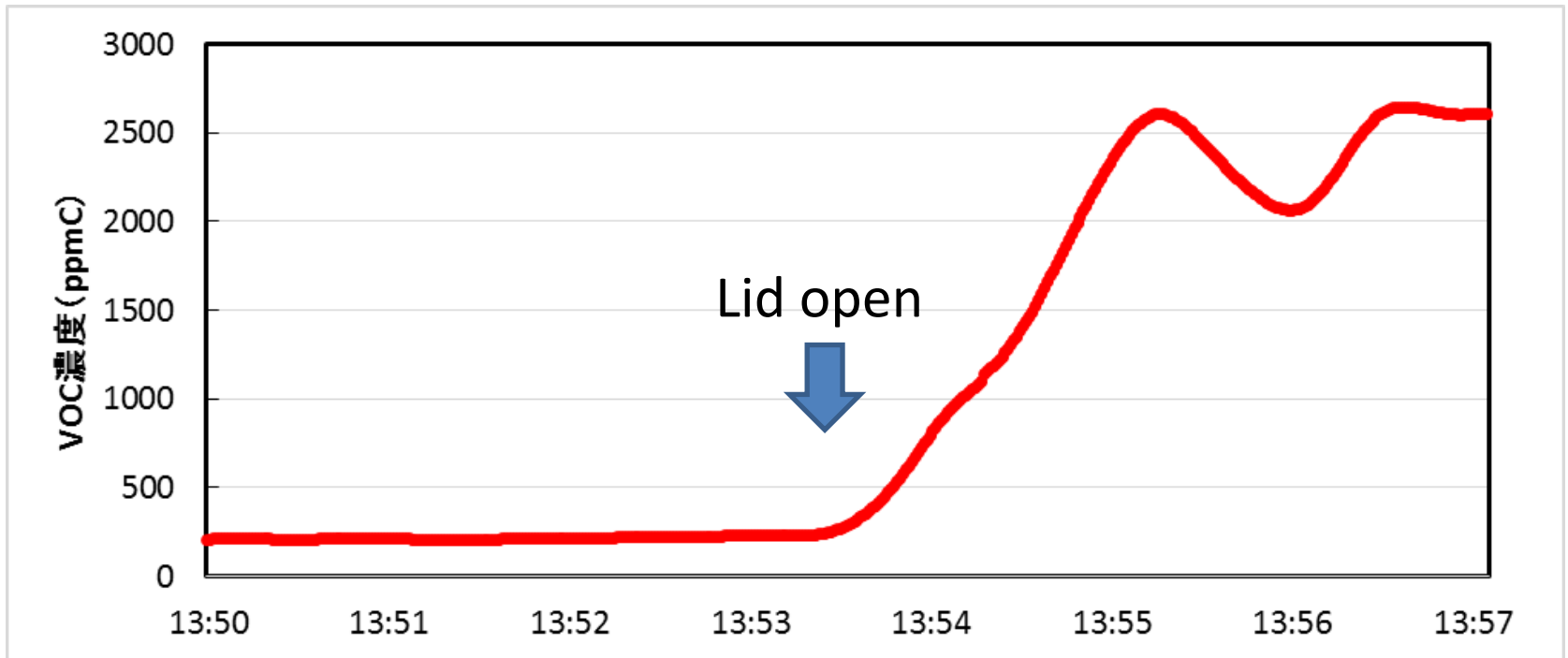
3600 ppmC

3400 ppmC

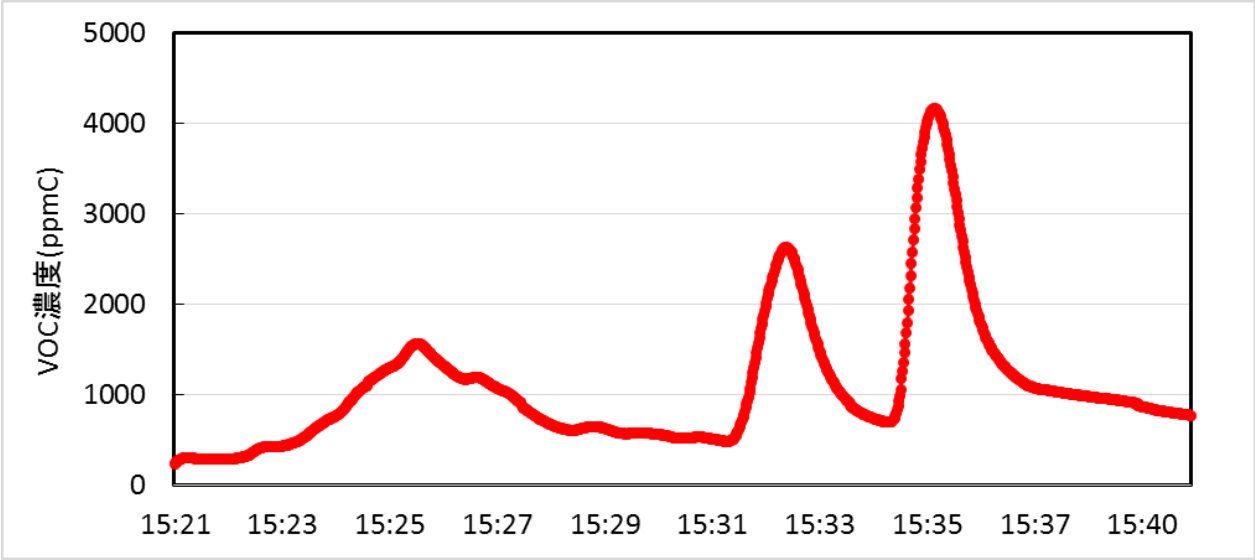
# Case 1. Outdoor painting



## Case 2. Used rags at a printing plant



# Case 3. Printing machine cleaning process



# Case 4. Measurement of concentration distribution in a printing plant



Table Height distribution of VOC concentration

Height Location	13 cm	160 cm	350 cm
A	270~380	250~270	220~250
B	250~270	320~330	260

Unit: ppmC

Thank you for your attention

